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VALUATION OF THE BENEFITS OF THE OVERSEER® NUTRIENT BUDGET MODEL

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Abstract

This project endeavours to value the benefit of the use of the OVERSEER model, focusing around its use in three key areas:

(i) As a research tool
(ii) As a tool to assist the efficiency of fertiliser use, and
(iii) As a tool to assist in nutrient management on-farm, particularly around limits on nutrient discharges.

The benefit value was based on expert opinion; people from a range of different perspectives with expertise in agri-environmental issues and the use of OVERSEER were interviewed so as to develop "with versus without" scenarios, with the difference being used as a basis to estimate the value.

As could be anticipated, information in a number of areas was relatively sparse, and a range of assumptions have been made. Using these assumptions, estimates of the benefit value are:

(i) As a research tool: $51 million/year (range $26 - $102 million)
(ii) As a tool to assist the efficiency of fertiliser use: $107 million/year (range $54 - $161 million)
(iii) As a tool to assist in nutrient management on-farm: $113 million/year (range $73 - $137 million)

This gives an overall estimated value of $271 million/year (range $153 - $400 million)

These figures must be regarded as indicative only, given the range of assumptions and extrapolations that lie behind them. This is particularly so for the estimate of value in assisting with nutrient management, and further work is required to obtain a more definitive figure.

A second component, of the value of continuing to develop OVERSEER, is more problematic. It is inherent within the value of benefits calculated that they are ongoing, and inherent within this is that the model continues to be developed. In this sense the ongoing value of the current model is only valid if the model is keep up to date and new science incorporated. While future development of OVERSEER is therefore essential in maintaining the current benefit of the model going forward, the addition of new science and features also means that the benefit from the model would increase.

Background

OVERSEER® is computer software which models the nutrient flows onto and off a farm. It is a long-term equilibrium model which was originally developed for advising/informing farmers and growers on nutrient management on-farm. Increasingly though it is used by regulatory authorities (e.g. Regional Councils) as a tool to measure and monitor nutrient losses (nitrogen and phosphorous) off-farm. As such it is increasingly used to underpin nutrient discharge policies and regulations, given that it is the only tool readily available to quantify diffuse discharges at a farm level.

The OVERSEER owners (Ministry for Primary Industries, The Fertiliser Association of NZ Inc, and AgResearch) wanted to calculate the value of the benefit of OVERSEER, to validate the benefits of past and current investments and inform future decisions around funding and development.

Within this, the OVERSEER Owners were looking to establish two "values":

(i) The value of the benefit of the current model; and

(ii) The value of continued development of the model in the sense of trying to establish the marginal/incremental benefit from further development; i.e. is the marginal benefit from future development greater than the cost.

Methodology

The methodological approach to this project was:

(i) A review of any relevant literature, and

(ii) (Mostly) interviews with personnel with a range of different perspectives as to the use of OVERSEER, and the benefits accruing. The interviewees were chosen (arbitrarily, but with an endeavour to cover a range of organisations) as people with expertise and experience in agri-environmental issues and the use of OVERSEER, and were interviewed as to their thoughts on the benefits accruing from OVERSEER, and particularly how the objectives sought could be achieved in the absence of OVERSEER. The intent was to endeavour to establish "with versus without" scenarios, with the difference being used as a basis to estimate the value of the benefit. As part of this, opinion was also sought as to the proportion of any value which would accrue to the use of OVERSEER.

The interviews were one on one; some face to face, while most were conducted over the phone.

Valuing Software

There are a number of methodologies available to value software (Wiederhold, 2007, Drommi et al, 2013), but ultimately these relate to a commercial value, and require a price on the software which can be related back to the cost of production, maintenance, and enhancement. None related to valuing the benefits from the use of the software.

Since its inception, OVERSEER has been disseminated free to users, on the premise that much of the development funding has been public money and hence the software is a "public good". This goes to the heart of the issue of valuing the benefit, as OVERSEER has a range of both tangible and intangible benefits. The primary beneficiary of OVERSEER is the agricultural sector, but this then has significant spill-over effects over the wider New Zealand economy.

The key benefits of OVERSEER could be summarised as:

(i) It has a direct benefit to research, in that it readily allows scientists to model systems being researched as to their impact on nutrient balances, thereby speeding up the whole process. It also provides a common platform for this modelling, which eliminates discrepancies if differing models were used;

(ii) It allows farmers to optimise their on-farm nutrient management, resulting in efficiencies in fertiliser usage, and hence helping to optimise profitability; and

(iii) By quantifying nutrient losses off-farm, it allows regulators to adopt effects based (i.e. output) policy and regulations rather than rules based on-farm input controls, which are inherently more inefficient with respect to their impact on farm productivity. This approach benefits both the agricultural sector and the wider community, in enabling flexibility in production systems while achieving environmental mitigation.

The paper concentrates on the value of the benefits of using OVERSEER, with respect to the three points noted above.

Benefit to Research

Currently the New Zealand primary sectors are grappling with the issue of farming within limits with respect to nutrient discharges and greenhouse gas emissions. This involves trade-offs between profitability and environmental footprint, which in turn requires the ability to quantify losses relative to changes in farm systems.

Within the research arena therefore, OVERSEER is used as the base environmental footprint model at the on-farm[1] level.

While losses can be measured within field trials and experiments, they need to be quantified as part of a farming system. In this respect OVERSEER offers a relatively quick and easy way to achieve this; the use of the model allows the researcher to more easily assess the system's impact on nutrient and greenhouse gas losses, as well as highlighting some of the unintended consequences of systems change.

If OVERSEER did not exist then it would be possible to work out nutrient/GHG discharges from first principles, but at the cost of significantly more time. Similarly, while it would be quite possible to develop spreadsheets to do these calculations, they:

(i) Would not necessarily cover all the nuances and inter-relationships captured by OVERSEER, and

[1] In this context farm = a land based operation, covering pastoral, horticulture, and cropping farms.

(ii) Would be very likely to be inconsistent between spreadsheets given that most scientists would want to construct their own.

The discussion around this issue highlighted two key points:

(i) For better or worse there is only one nutrient budget model readily available - OVERSEER - so there are no inconsistencies, and

(ii) The scientists talked to quickly affirmed that if they didn't have OVERSEER, such a model would have to be built as they didn't fancy working everything out from first principles and by long-hand.

The key benefits to research therefore are:

1. The time and effort saved by having a model such as OVERSEER to quickly calculate environmental footprints, and

2. Having the one model means there is consistency (assuming the OVERSEER Best Practice Data Input Standards are followed) in calculations between differing trials and science groups, and as part of this provides a common "language" for discussions around nutrient management research.

In addition, there are other direct benefits:

3. Using the model readily informs if there are research gaps which in turn aids and informs research development. Examples of this would include; the fate of urine and the ability to model this, and nitrogen in irrigated pasture;

4. Having OVERSEER means that there is a vehicle to use research in a systems context, which is of direct benefit to both the researcher and the industry; and

5. It also offers a direct-to-market technology transfer tool for research results.

The question that then arises, is how to monetise these benefits. The short answer is "*with difficulty*", although a rough estimate can be generated based on existing data on research spend on agricultural and environmental science and the extent to which OVERSEER is used. Current spending on agricultural and environmental research in NZ is in the order of;

Table 1: Agricultural and Environmental Expenditure in NZ[2]

	$m/year
General Agricultural R&D (2012, Govt spend)	213
General Environmental R&D (2012, Govt spend)	196
General Agricultural R&D (2012, Business spend)	194
General Environmental R&D (2012, Business spend)	17
Total	620

Source: Statistics NZ

[2] Information to differentiate this research into topic area was not readily available

The degree to which OVERSEER would be used within this work would vary widely. While there are some research programmes, e.g. Pastoral 21, Greenhouse Gas Mitigation and Adaption, some of the PGP programmes, where it would be used heavily, there are other areas, particularly in some of the non-agricultural environmental R&D, where it would be seldom used if at all.

In addition to this the above expenditure would also include the overhead costs of the R&D establishment (e.g. CRI's), where the existence or otherwise of OVERSEER would have little bearing.

It must be noted that the research would continue in the absence of OVERSEER; the benefit of OVERSEER is in reducing time and inconsistency costs associated with the research. If an estimate (by the author) of 5% of the value of the environmental R&D, and 10% of the agricultural R&D is ascribed to this, the benefit is $51 million per year, with a range of $26 million (2.5% and 5% respectively) to $102 million (10% and 20%).

Benefit for Efficiency of Fertiliser Usage

Maintenance Fertiliser

From the mid 1980's to the mid 1990's fertiliser recommendations in New Zealand around phosphorous and sulphur were very largely based on the Cornforth and Sinclair model (Cornforth & Sinclair 1984) which was based on static models that balanced fertiliser inputs with nutrient losses, but could not predict the effect of different fertiliser rates on soil fertility and farm production. The advent of "Outlook" (Metherell et al 1997 – an econometric model that also incorporated economics) and shortly thereafter OVERSEER (Edmeades, 2012) saw these recommendations based on a dynamic biophysical model of P and S nutrient cycling, and pasture and animal production in pastoral farms.

As part of the interviews, the question was raised as to how farmers would obtain best fertiliser recommendation advice in the absence of OVERSEER, particularly pertaining to maintenance applications of phosphorous. Note this related to pastoral farming, as OVERSEER is not extensively used at present for fertiliser recommendations in horticulture or arable cropping.

It was noted that OVERSEER is not designed to deliver fertiliser recommendations, but is used by advisers to inform the development of their recommendations (based on the models estimate of maintenance requirements)

The general responses were:

- There would be a need to go back to guidelines and look-up tables based on the Cornforth-Sinclair model.

- There would be an increase in the level of soil testing to monitor soil P levels, with fertiliser application adjusted as trends became apparent.

- Many would go back to "rule of thumb" approaches

- The cost (of fertiliser recommendations) may well increase as advisors would need more time to calculate recommendations

All noted that in the absence of OVERSEER fertiliser recommendations would be relatively more simplistic, as it would be very difficult to take into account all the variables that OVERSEER does, such as the intensity of the farming system, effluent inputs, level of supplementary feeding, etc.

There was a range of opinion as to whether more or less fertiliser would be applied. Some felt that advisers would be more cautious, with less fertiliser applied, while most felt the opposite – that more fertiliser than necessary would be applied. Most respondents also felt that there would be a greater degree of inconsistency in recommendations.

There was some comment that OVERSEER has limitations with respect to fertiliser recommendations; it couldn't establish where on the nutrient response curve the farm is, and lacked the ability to calculate economically optimum applications (aka the econometric model). But that it was good for scenario comparisons.

The question was raised with respondents as to the difference in the efficiency of P fertiliser usage with or without OVERSEER (given that in the "with" scenario it was used according to best practice guidelines).

The responses varied from nil (didn't think OVERSEER added any more accuracy, but just codifies existing knowledge) through to up to 60%. Most responses were in the 10-30% improvement range.

This could be used as the basis of determining a value of the benefit of OVERSEER in this area.

Table 2: Phosphorus Usage in New Zealand (000t)

1999/00	**177.3**	**2007/08**	**170.0**
2000/01	**200.9**	**2008/09**	**114.0**
2001/02	**211.3**	**2009/10**	**139.8**
2002/03	**208.1**	**2010/11**	**147.4**
2003/04	**217.7**	**2011/12**	**148.6**
2004/05	**218.6**	**2012/13**	**132.5**
2005/06	**188.6**	**2013/14**	**138.2**
2006/07	**177.2**		

Source: Fertiliser Association of NZ

The 5-year average 2009/10 – 2013/14 is 141,300 tonnes of phosphorus, or the equivalent of 1.57 million tonnes of superphosphate.

Given the following assumptions:

(i) Proportion of phosphorus used in the horticulture and arable sectors = 15% (No direct statistics are available. Horticulture and arable take up 6% of agricultural land use, but use more fertiliser per unit area)

(ii) Proportion of the remainder used for maintenance (on pastoral farms) = 75%

(iii) Applied cost of superphosphate = $400/tonne

Assuming a 20% improvement in fertiliser usage efficiency (as a mid-point on the above response range), then the value = $80 million/year, with a range of $40m (10% improvement) through to $120m (30% improvement).

[Mid-point calculation being: 1.57 million x .85 (take out the 15% for horticulture & arable) x .75 x $400]

Differential Fertiliser Application on Dairy Effluent Blocks

Another component of the benefit of OVERSEER is its role in identifying the need for differential fertiliser recommendations on dairy effluent blocks both as a cost saving measure (reduced need for fertiliser) and as a preventative animal health option (reduced potassium inputs).

The value of more efficient fertiliser application to dairy effluent blocks can be estimated as follows:

Table 3: Fertiliser Value of Dairy Effluent

	Nitrogen	Phosphorous	Potassium
kg/100 cows*			
System 1	782	90	750
System 2	1,058	135	1,050
System 3	1,150	162	1,075
Av Farm Value**			
System 1	$4,037	$591	$4,306
System 2	$5,462	$886	$6,028
System 3	$5,937	$1,063	$6,171

* Source: Dairy NZ 2013.
** Average farm = 413 cows/144 ha (LIC 2015). Current August 2015 fertiliser prices used

The value of the saving in phosphorous is very likely to be a double count with the maintenance saving calculated earlier, and as such is taken out of the subsequent calculations discussed below.

The weighted average[3] saving across the farm systems is $11,451 for the average farm, excluding phosphorous.

As per the earlier discussion, in the absence of OVERSEER, fertiliser applications on dairy effluent areas can be calculated from first principles. The benefit of OVERSEER is that the calculation is done far more expeditiously, and probably far more accurately. Another benefit of OVERSEER is that it can easily be used, in a reverse sense, for calculating the required effluent area for an individual farm.

[3] Based on 30% of farms = System 1 or 2, 41% = System 3, 29% = System 4 or 5. Dairy NZ 2015

If the same parameters for the improvement in efficiency via OVERSEER is used as earlier (20% mid-point, range 10-30%), and extrapolated over the national herd (11,927 farms LIC 2015), the benefit gained is $27.3 million (range $13.6m - $41m)

The overall annual benefit from more efficient fertiliser usage (maintenance and effluent savings) is therefore $107.3 million, with a range of $53.6 to $161 million.

Benefit for Nutrient Management Controls

This component relates to the use of OVERSEER in managing nutrient and greenhouse gas losses from farm. The main purpose of the discussions was to endeavour to establish a "with versus without" scenario which could then be possibly measured so as to establish the benefit of using OVERSEER in this arena.

Nutrient Management Control in the Absence of OVERSEER

The discussion here was centred on how nutrient discharge limits could be set and monitored at a farm level.

A number of respondents noted that while water quality levels could still be measured within water bodies, the issue then became how to ascribe this to individual farms. A number of suggestions around this;

(i) Direct measurement of nitrogen leaching via lysimeters, although the high cost of this (upwards of $100,000/farm) would prohibit it in the majority of instances;

(ii) Operate at a sub-catchment level; if the farms were reasonably homogenous then ascribe equal limits to each farm;

(iii) Measure the water quality in streams at the top and bottom of each farm and use this as the basis for limits/monitoring, although Southland work has shown this to be somewhat ineffective (Cameron, 2015);

(iv) Use the results of R&D and apply "rules of thumb" to setting limits;

(v) Get farmers to use GAP/MGM (Good Agricultural Practices/Matrix of Good Management) approaches – know from R&D what general impact these have on nutrient losses. But difficult to establish a link between this approach and nutrient losses over time;

(vi) Use an "input less output" approach; it would be possible to calculate (say) the amount of nitrogen going into a farm system, and the output in terms of product going out the gate. The difference would be "lost" nitrogen which would be the factor used to set the limit/monitor losses, although it would not be possible to differentiate these "losses", e.g. whether nutrient or greenhouse gas. This approach would be significantly cruder relative to OVERSEER.

Most felt that while there are various pros and cons around the above approaches, none would be as efficient as using OVERSEER.

Almost all (90%) the interviewees felt that the most likely approach in the absence of OVERSEER was that the Councils would need to go to an input control type approach.

Most felt that the input controls would need to be relatively onerous (i.e. across the board) in order to ensure any reductions were achieved. Several interviewees cited the European experience, where the main control was on stocking rate, which was readily circumvented by increasing the level of feeding via supplements to achieve a higher per animal production, thereby somewhat negating the purpose of the control.

One suggestions was to put a cap on production (e.g. for dairying, stipulate a maximum production per hectare). The theory being that this would work backwards to restrict inputs.

The end result would be strict controls affecting the farming system. So for (a hypothetical) example, if the water quality testing of adjacent water bodies indicated that a 30% reduction in nitrogen was required, then stocking rates, fertiliser inputs, supplementary feed input from outside the farm, would all have to be reduced by 30%. [Or whatever the relative figure was – responses are not necessarily linear; for example if stocking rate is reduced, animals will eat more pasture, thereby increasing their per head production, as well as excreting more nitrogen. Doole (2013b) notes:

Input-based policies suffer from a number of complications. First, within these farming systems, there is invariably a low correlation between the use of a single farm input and N leaching. For example, stocking rate is a key determinant of N leaching, but large stocking rate reductions of 17 and 30 per cent are still required to achieve N leaching reductions of 10 and 20 per cent, respectively, due to the imperfect correlation. This finding can likely be extrapolated to all grazing systems, given the complicated relationship between input use, production and nitrate leaching (de Klein et al. 2010). Second, leaching levels may remain high under an input-based policy because of substitution with unrestricted inputs. For example, allowing no use of N fertiliser reduces profit by around 30 per cent, but only decreases leaching by around 5 per cent, as supplement use increases by 80 per cent to sustain stocking rate. This behaviour is expected to hold for grazing systems generally, provided that there is some degree of substitutability between the relevant factors. Third, policies that restrict the use of two inputs are costly. For example, restricting nitrogen fertiliser application and stocking rate reduces profit by 30 and 40 per cent for the 10 and 20 per cent N leaching goals, respectively].

Respondents felt that in the absence of any quantifiable data, Councils would tend to be more precautionary, and hence err on the conservative side. The advent of input controls would also have other issues;

(i) Most Councils felt that an input control system would involve greater cost in auditing farm compliance, although some felt that the cost would be similar if not less than an OVERSEER/output approach – they felt that an input control approach would actually be simpler to enforce. The experience in the Netherlands of the MINAS (Mineral Accounting System) program – a mechanism to regulate nitrogen and phosphorous surpluses, indicated high administration and transaction costs (OECD 2005).

(ii) While it would be possible to monitor water quality in adjacent water bodies, trends at an individual farm level could not be monitored.

(iii) All respondents felt that an input control approach would stifle innovation, relative to an output based approach (based around using OVERSEER). Comments were:

- If there is a cap on nutrient losses, then we want to encourage innovation as much as possible to maintain productivity/profitability.
- Input control would constrain farm management; the advantage of OVERSEER is that it allows farmers to explore different management scenarios and hence increases/allows flexibility.
- Within the horticultural sector, farmers often grow a range of crops on different parts of the farm both within and between years as part of their rotation management. The use of models (to measure nutrient discharges) can ensure this continues, whereas input controls would seriously disrupt this.
- Example 1. A dairy farmer was seeking to convert a sheep & beef property to dairying. The nitrogen discharge limit was only 10% above the current sheep & beef level. The farmer converted the farm based on a fully housed/cut & carry operation. The end result being a much more intensive system but within the nitrogen discharge limit. The Council noted that without OVERSEER to model this, they would not have allowed the development to happen.
- Example 2. A farmer reduced his nitrogen leaching well below the set limit, and was able to transfer the difference to other land and intensify it, while staying within the overall limit (of both blocks of land). Again this would not be possible without OVERSEER.

(iv) While most felt that innovation would be enhanced under an output based limit system, some did note that the advent of regulation (aka input controls) often stimulates innovation as people try to find ways around the constraint.

Valuing the "With Versus Without" Gap

Some limited work has been done in New Zealand around the cost of input controls (Doole 2010, 2013a, 2013b), although this was not a comparison between input control versus output based regulatory systems.

In the 2013a paper, based on a Waikato River sub-catchment, Doole did provide some figures that illustrate a possible value; for the case study catchment the cost of achieving the required discharge limits under a cap and trade system was $0.6 million, or $1,807/dairy farm, as opposed to $5.1 million, or $15,361/farm under a uniform cap on stocking rates.

A cap and trade system involving diffuse discharges, could not operate without OVERSEER, whereas a uniform cap on stocking rate is simply an input control which does not require OVERSEER. In this sense therefore, a reasonable component of the value differential of the cap & trade system could be attributed to OVERSEER.

This question was posed to the interviewees; given the example above, what proportion of the benefit could be accrued to OVERSEER, given its critical role in the cap and trade process.

Responses:

1. Some felt that a cap and trade scheme could operate in the absence of OVERSEER, utilising other units of trade, e.g. cow numbers, gross nitrogen input/output. Most of the Councils felt that, if they were to allow a cap and trade system, it would be very unlikely that they would consider anything other than an OVERSEER-based system, trading in either nitrogen or phosphorous units, as the alternatives were too uncertain.

2. A few felt that OVERSEER wasn't suitable to allow trading, given changes in calculated output figures as the result of Version changes. They felt that this was too much of a disruptor, and either another mechanism other than OVERSEER be found as a monitoring/measurement tool, or that the Council would have to stay with a certain version of OVERSEER – which then has the disadvantage of not allowing mitigation strategies to be claimed as they are added to future versions of OVERSEER.

3. Most agreed that a cap and trade system involving diffuse discharges could not operate without OVERSEER. The proportion of the benefit of this system they attributed to OVERSEER varied widely, depending on how they valued other contributors, such as the policy framework.

Some (25%) gave it a 40-50% attribution, whereas the majority (70%) indicated 70-100% (with some just noting "very high") of the benefit, based mainly around the need for a tool that could measure outputs and allow monitoring of this over time.

These two factors could then be used as a basis to estimate a value of the benefit of OVERSEER in managing nutrient loss from farms. Namely;

(i) An estimate of the value of an outputs based system based around the use of OVERSEER relative to an inputs based system, and

(ii) An estimate of the contribution of OVERSEER to this benefit, based on an "expert opinion" basis.

An example of this would be an extrapolation of the benefit noted above as calculated by Doole et al (2013a). This is an extrapolation too far, but illustrates the methodology:

- Difference in benefit between the "with/without" OVERSEER approach = $13,544/dairy farm
- Number of dairy farms in New Zealand = 11,927 (LIC/Dairy NZ 2015)
- Proportion of benefit attributable to OVERSEER = 70%

Overall OVERSEER benefit = $113 million/year, with a range of $73 million (45% of the benefit attributable to OVERSEER) through to $137 million (85% of the benefit attributable).

Further work would be required to obtain more representative data at a national level that could be extrapolated with more confidence. Discussions (Doole pers com) indicate that a more definite value could be derived, via modelling representative farms across different sectors (dairy, sheep & beef, horticulture, arable), across a range of representative regions, as a basis to identify the value difference of the gap between an input control approach and a nutrient output-based approach.

Consultancy Value

Somewhat similar to the research component discussed earlier, there is also a value which accrues to consultancy work. In noting this though, the vast bulk of this work is modelling work involving tools such as Farmax to consider various farm management scenarios and then transferring this into OVERSEER to consider the nutrient discharge impact.

This is largely done for farmers directly, or for Regional Councils, in endeavouring to find systems that can comply with nutrient discharge limits. This is part of the issue discussed above in Sections 6.1 and 6.2 above, and in that respect much of the value of the benefit is (or will be) captured as part of that calculation.

Other Benefits

As part of the discussions, other benefits of OVERSEER were also noted:

(i) It provides a tool for education around nutrient and greenhouse gas management, with three Universities using it in their courses.

(ii) It provides a consistent assessment across a range of farm systems and land management across New Zealand. This has advantages for inter-regional comparisons, and capability – someone trained in one region can easily work in another.

(iii) It has advantages for advisors being certified in nutrient management.

(iv) OVERSEER has also provided a forum where production and environmental issues can be discussed contemporaneously. Previously they tended to be discussed in isolation to each other.

(v) One of the benefits of OVERSEER was that it is possible to evaluate the cost effectiveness of different mitigation practices; in the absence of OVERSEER this would be very difficult and could lead to mitigations with limited efficacy being invested in.

(vi) In a similar vein, the potential impact of nutrient discharge constraints on land values was raised, with the thought that there is a value to the financial sector in not (or limiting) lending to farms at risk. In this sense, OVERSEER is acting as a risk management tool. While banks are lending to farmers on the basis the farmers are compliant within any consent limits, and budgets provided are assumed to be operating within any nutrient discharge limits (Williams, pers com), the advent of nutrient discharge constraints does bring a new complexity to the situation. While consents for (say) effluent systems are relatively straight forward, nutrient discharge limits can mean a fundamental change to the farm system, which has implications for asset values and/or cash flows.

If, for example, a farmer buys a farm in a nutrient constrained catchment, and particularly if land use is to be changed, the bank must be confident that the asset value will be maintained and debt servicing won't be compromised. In this sense OVERSEER definitely has a value to the banks, although this is (again) difficult to quantify (Holgate, pers com).

Summary of the Benefit of OVERSEER

As outlined in this paper, estimates have been made of the various components of the value of the benefit of OVERSEER. Summarised, they are:

1. Benefit to research, estimated at $51 million/year ($26 - $102 million)

2. Benefit in increasing the efficiency of fertiliser usage, estimated at $107 million/year ($54 - $161 million)

3. Benefit in nutrient discharge management, estimated at $113 million/year ($73 - $137 million)

This gives a total benefit of $271 million/year, with a range of $153 – $400 million.

Taking this as an annuity in perpetuity, and converting it to a Present Value figure, using the Treasury discount rate of 8% (real), over 50 years, the benefit value is approximately $3.3 billion, within a range of $1.9 billion to $4.9 billion.

These figures are indicative only, given the assumptions and extrapolations made.

It must also be noted that the calculation of its benefit for nutrient management has ignored several sectors, e.g. sheep & beef, horticulture, and arable, as no data is available – notwithstanding that horticulture and arable cropping are not currently major users of OVERSEER.

The Worth of Future Development of OVERSEER

The issue behind this is whether it’s worth continuing to invest in OVERSEER, i.e. is the marginal or incremental benefit from future development greater than the cost.

Given the issues in determining value of the benefits of the model, this question is very difficult to ascertain, and would vary depending on the differing improvements or expansions; a small improvement in accuracy may have significant benefits, whereas an improvement for a particular farming system may have limited (wider) benefits. It is inherent within the value of benefits calculated in this paper that they are ongoing, and inherent within this is that the model continues to be developed. In this sense the ongoing value of the current model (as calculated by the NPV) is only valid if the model is keep up to date and new science incorporated. While future development of OVERSEER is therefore essential in maintaining the current benefit of the model going forward, the addition of new science and features also means that the benefit from the model would increase.

There was unanimous agreement from the interviewees there needed to be continuous development of OVERSEER; no-one wanted to the see development stall at the current Version 6.2.0, and everyone felt there needed to be a “big bang” in funding in order to catch-up on new science in some areas, expand and incorporate validation work, and ensure sufficient funding into the future. It was noted that the “wish-list” of OVERSEER improvements was quite long, and again serious funding is needed to address this.

There were some cautions with this, particularly the need to ensure that there are sufficient people resources behind OVERSEER to (a) develop the model, and (b) maintain and provide servicing help as the model expands.

It was also noted that:

(i) OVERSEER will largely be in a catch-up mode as new science comes to hand, and

(ii) In as much as it was not developed as a regulatory tool, but is increasingly used as one, work is required as to how best to use it in such a role. (Or, how to frame regulations to best use OVERSEER).

(iii) Farming in New Zealand faces a range of issues, including rising on-farm cost inflation. The future development of OVERSEER helps to address this by helping to maintain the flexibility of farming systems.

(iv) OVERSEER offers the possibility for greenhouse gas trading at a farm level if that eventuates.

In posing the above question, i.e. is further investment in OVERSEER likely to have benefits greater than costs, most felt that the answer was yes, even though this was largely an act of faith. But everyone felt that OVERSEER, for all its issues, was far superior to any alternative.

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