



MPI Policy and Trade

30 October 2025

Including EcoPond Generation 2 for dairy cattle

Author: Sophie Mead, Policy Analyst, Greenhouse Gas Inventory Team

Purpose of this paper

1. This paper seeks a recommendation from the Agricultural Inventory Advisory Panel (the Panel) regarding whether the Generation 2 formulation and treatment method of EcoPond should be included in the inventory based on research recently completed by Keith Cameron and Hong Di of Lincoln University (Cameron, et al., 2025). Two options are proposed:
 - a. Adopt the proposed methodology for including EcoPond in the inventory, including a **92 percent** mitigation factor for treated effluent and a **6-week efficacy period**; or
 - b. Continue with the status quo i.e., Provisional recognition of EcoPond in the Inventory, pending the completion of an acceptable 'capstone' study.
2. Attached to this paper are the following:
 - a. Cameron K, and Di H. 2025. EcoPond Generation #2 results: Report to the MPI Agricultural Inventory Advisory Panel. Centre for Soil & Environmental Research, Lincoln University.
 - b. Independent expert reviews by Seth Laurensen, Andrew Curtis, and Jiafa Luo;
 - c. Change approval forms to accompany these reviews (Andrew's review is contained within the form);
 - d. 2024 Panel Paper on the inclusion of EcoPond by Catherine Sangster; and
 - e. Report presented to the Panel in 2024: Clough T, Cameron K, and Di H. 2024. The Case for Including EcoPond® Generation#2 in the New Zealand Greenhouse Gas Inventory as a Methane Mitigation Tool for Dairy Cattle Manure Management.

Background – Outcome of the 2023 and 2024 meetings

2023 Agriculture Inventory Advisory Panel Meeting

3. At the 2023 panel meeting the Panel were presented with research and a briefing report recommending the inclusion of EcoPond in the inventory. This report outlined the research supporting the inclusion of the Generation 1 treatment and a method for the inclusion of the technology. After clarifying questions were answered and minor changes were made the Panel recommended the inclusion of the Generation 1 technology.
4. Early results supporting the Generation 2 formulation were also presented. The Panel were supportive of the Generation 2 findings but were not comfortable recommending the Generation 2 formulation for inclusion, because the Panel wanted to see the results of further trials. The Panel requested further trials, demonstrating the efficacy of Generation 2 while following a standard operating procedure, and suggested at least one trial in an open lagoon set up to mimic common farm practices.

5. In 2024 and 2025 Tim Clough, Keith Cameron, and Hong Di of Lincoln University conducted additional trials using the Generation 2 formulation, and an improved and more cost-effective method for treating the effluent. This was done by using a truck delivery system to directly dose the anaerobic lagoon until a specified redox potential is achieved in the anaerobic lagoon. This method is referred to as shock dosing.

2024 Agriculture Inventory Advisory Panel Meeting

6. More detail on what was presented to the Panel in 2024 is available in the Panel Paper - *Including EcoPond Generation 2 for dairy cattle*.
7. In the 2024 panel meeting, the Panel recommended the inventory be modified to account for the "Generation 2" formula and shock dosing procedure of EcoPond using a **6-week efficacy period** and a methane reduction of **95%**. However, this recommendation was provisional upon the satisfaction of the following conditions:
 - a. A comprehensive and detailed **standard operating procedure (SOP)** is provided to MPI that clearly sets out the operating instructions for how the additives (polyferric sulphate and sulphuric acid) will be pumped into the ponds, the criteria for determining the amount of additive to be added, details on pumps and inlets (e.g. depths, distance apart), and other relevant instructions, from the entry of the delivery truck on the farm to its departure.
 - b. An additional '**capstone**' trial on a full-scale pond that follows the SOP as closely as possible. Inclusion of the method in the inventory is subject to this trial demonstrating an emission reduction consistent with previously reported values.
 - c. Successful resolution of questions and potential issues identified in some sections of the research report. This includes:
 - i. Clarification of Figure 17 which details the results of the full farm-scale effluent pond trial. The Panel commented that the graph suggests that methane emissions fall just prior to the start of the treatment and asked that this be clarified (i.e. did emissions actually fall before the start of the treatment as suggested by the two brown points just before the first dose or is this just a formatting issue?)
 - ii. Additional clarification on the description of the full-scale trial, where it is stated that two doses were applied at around day 250 (and is indicated by the two dashed lines in Figure 17 [REDACTED]). This initial combined treatment raised the redox potential from -330 mV to +360 mV." and "The two treatments (around day 250) were all that was used to treat the pond." The Panel were interested to know why a double dose was applied as this does not seem to be part of the SOP.
 - iii. Clarification on the effect of lowering the amount of waste material in the pond. When the pond is partially emptied or drained, how does this affect the emissions reductions from the EcoPond treatment?
 - iv. In the executive summary reductions in ammonia emissions are listed as a co-benefit from the use of EcoPond. The Panel asked for more information to support that statement.
8. Notes from the 2024 Panel meeting minutes detail the comments of the Panel members on including EcoPond into the inventory, including the concerns around whether the

results show the treatment is effective, as methane emissions had declined to low levels before the treatment was applied.

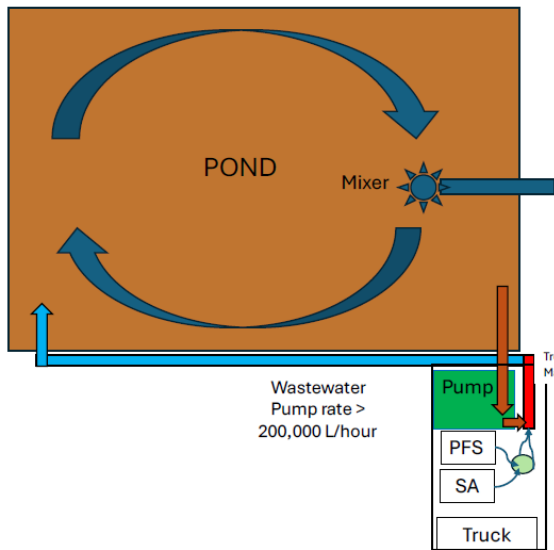
9. The full-scale pond trial was also discussed in detail as Panel members agreed this gave the best insight into how the technology would perform on-farm. It was noted that most of the evidence came mostly from small-scale experiments that seek to simulate manure ponds, and that there was only one full-scale, real-world pond trial. The Panel discussed whether this single full-scale trial, and the specific methodology and results for this trial, provided sufficient evidence for inclusion of EcoPond in the inventory as proposed.
10. The Panel also noted that while existing trials provide compelling evidence of the effectiveness of the intervention in general, none of the trials replicate the suggested on-farm standard operating procedure. The Panel agreed that because of this limitation, there was not sufficient evidence to include EcoPond in the inventory based on the proposed standard operating procedure. The Panel agreed that for inclusion in the inventory, there was a need for a capstone trial replicating the standard operating procedure of treatment exactly as would be specified and used on farm. This would assist with quantifying the efficacy of the technology and how long the treatment is effective, when it is used in real-world farming conditions.
11. A commercial EcoPond truck-mounted Generation 2 treatment system has now been developed by EcoPond Ltd, and this truck-mounted treatment system has been trialled in Canterbury following the standard operating procedures for Gen#2 treatment.
12. Twenty-four field trials have been completed using the EcoPond Gen#2 treatment protocol. Some were conducted on full scale effluent ponds and others in macrocosms. A selection of these trials is outlined below to help the Panel decide:
 - a. If the concerns raised during the 2024 meeting have been resolved sufficiently to allow point (b) below
 - b. to move from a provisional to a final recommendation for inclusion of the EcoPond Generation 2 treatment in the inventory.

Standard operating procedure

13. In early 2025 Tim Clough, Keith Cameron and Hong Di provided MPI with a standard operating procedure detailing:
 - a. Customer setup
 - b. Dosing SOP
 - c. Tracking of dosing information
 - d. Dosing regime and buffer
 - e. Pond management advice for farmers
14. The SOP is detailed in Appendix One.

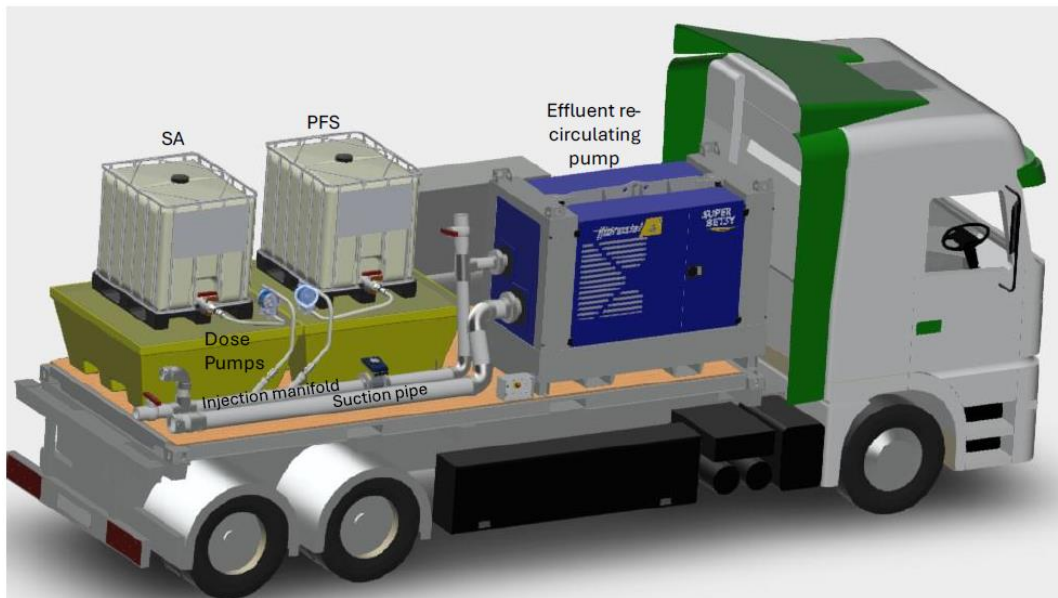
Figure 1: Concept of EcoPond Generation 2 shock dosing of a pond using a delivery truck (Cameron and Di, 2025)

ECOPOND TRUCK TREATMENT OF EFFLUENT POND - CONCEPT



1. Self-priming Wastewater pump on the truck transfers effluent from the pond into the 'Treatment Manifold'.
2. EcoPond additives dosed into the Manifold and the treated effluent is pumped back into the pond.
3. The treatment continues until a Redox potential (Eh) of $> +200$ mV is achieved in the effluent being pumped into the Treatment Manifold from the pond (i.e. represents the Redox of the pond).
4. Treated effluent is mixed into the pond via the discharge pipe from the pump and mixed with the pond mixer.
5. Pipes are washed and disconnected then truck drives to the next farm.

Figure 2: Engineering designs for an EcoPond treatment delivery truck (Cameron and Di, 2025)



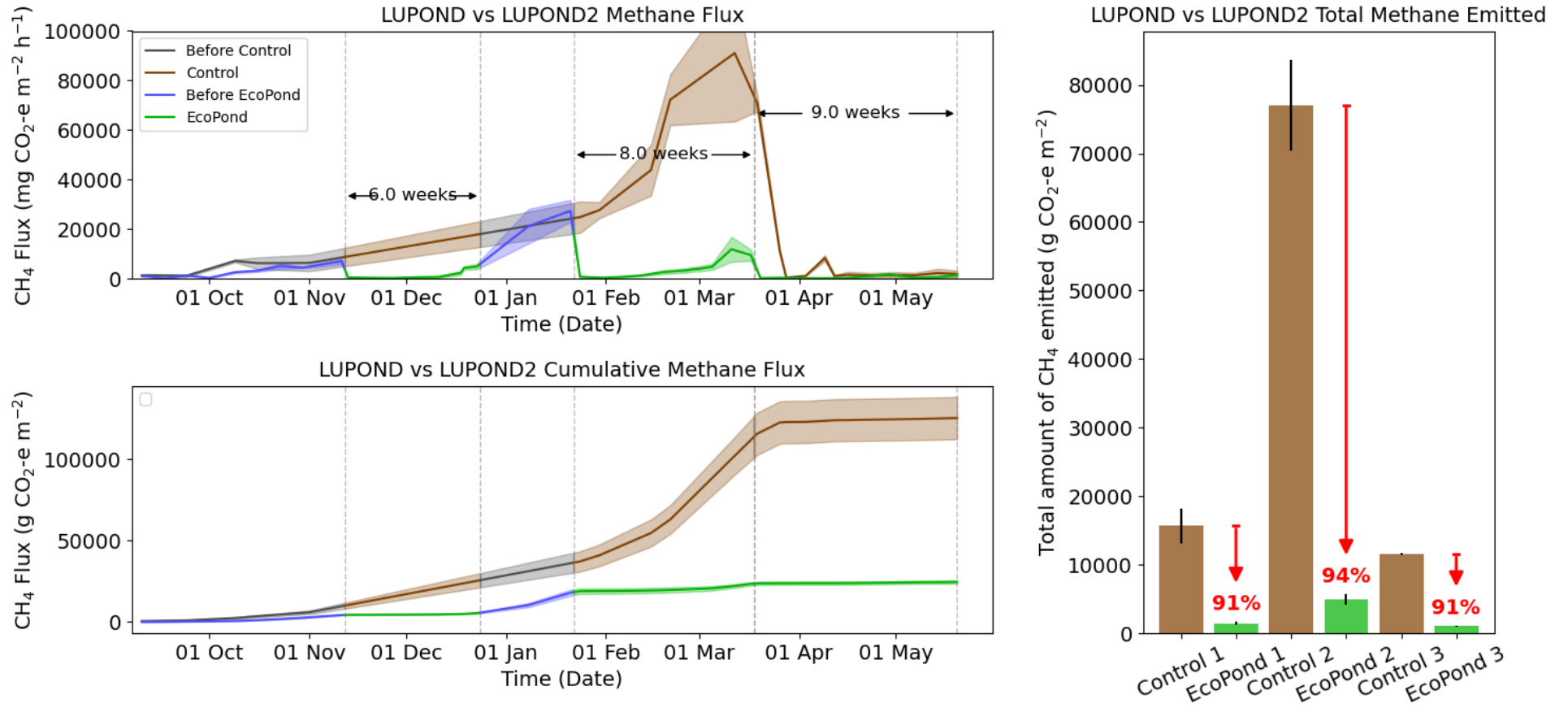
The 'Capstone Trial'

15. The Capstone trial was designed to test the truck-mounted EcoPond Gen#2 treatment system and the standard operating procedure in a commercial dairy farm pond. The trial was conducted on the Lincoln University Dairy Farm¹. The farm has a 1 million litre effluent anaerobic lagoon.
16. The pond was treated on the 12th of November 2024, the 22nd of January (10 weeks) and the 18th of March 2025 (8 weeks).
17. Following each of the three treatments, regular twice daily additions of fresh effluent were added into the pond following each milking. Effluent was not pumped out and irrigated for 5 – 7 days following the dosage of the pond. After this period, the pond was maintained normally by staff.
18. Each dosage lowered methane emission flux by 91 – 94%, and that effect lasted from 6 – 9 weeks before methane emissions began to increase again and another dosage was needed.
 - a. Treatment from the 12th of November reduced the pond's methane emission flux by 91% during the subsequent 6 weeks following the dosage.
 - b. In the 8 weeks following the second dosage of the pond (January 2025) the methane emission flux decreased by over 94%.
 - c. In the 9 weeks following the third dosage of the pond (March 2025), the methane emission flux decreased by over 91%.
19. The results of this capstone trial can be viewed in figure 3.
20. The mean reduction across the three treatments was 92%.

¹ [Lincoln University Dairy Farm](#) is a 160 ha milking platform owned by Lincoln University and managed by the South Island Dairying Development Centre. There are approximately 3.5 cows per hectare, and approximately 560 cows on farm.



Figure 3: Results of the Capstone trial following the three treatments (November 2024, January and March 2025).





Additional trials on full scale effluent ponds

21. Four additional full scale effluent ponds were treated in 2025.
22. A new automated methane measurement pontoon (AMP) was developed to improve efficiency working across four farms. This AMP consists of a gas-tight sealed buoy to act as a gas collection chamber. It is equipped with an automatic vent on top of the chamber and a fan within the chamber. Gas in the chamber is recirculated through a high precision photo-acoustic trace gas analyser (Innova 1512).
23. Farms 1 and 2 had a single effluent pond system with a central stirrer and held approximately 1000 m³ and 1500 m³ of water at the time of treatment respectively.
24. Farms 3 and 4 had a two-pond system. For both farms, the first pond was treated because this 'settling pond' had greater amounts of organic material and is the source of most of the methane emissions from manure management on these farms. The ponds did not have a stirrer and held approximately 1,700 m³ and 1,100 m³ of water at the time of treatment respectively.
25. The thick sludge at farms 3 and 4 was challenging to treat, in the case of farm 4 the farmer utilised a tractor driven stirrer that was used during the treatment.
26. All four farms followed a consistent measurement protocol:
 - a. Measurements were collected automatically over a 16 to 18 hour period.
 - b. Within each period, measurements were taken in **20-minute sessions**, spaced **30 minutes apart**.
 - c. During each 20-minute session, methane concentration within the AMP was sampled every **72 seconds** using Innova 1512.
 - d. After each 20-minute measurement session, the butterfly valve on top of the chamber was opened automatically and the fan in the chamber vented the gas out for 10-minutes, before measurement was restarted automatically.
27. Methane measurements were taken approximately 3 weeks prior to treatment, and 2 weeks following treatment.
28. The methane flux was calculated for each measurement, as well as the cumulative flux over all measurements from a pond on a particular day.
29. Results from the additional capstone trial farms show an **average reduction in methane emissions of 95%** using the standard operating procedure.

Table 1: Summary of additional full scale effluent pond trials

Farm	System	Stirrer	Pond Volume	Reduction (%)
Additional Farm #1	single effluent pond	central stirrer	1,000 m ³	97%
Additional Farm #2	single effluent pond	central stirrer	1,500 m ³	98%
Additional Farm #3	two-pond system	no stirrer	1,700 m ³	86%
Additional Farm #4	two-pond system	tractor driven stirrer	1,100 m ³	98%
Average				95%

Regional data on Gen#2 efficacy in macrocosms

30. 10 EcoPond measurement units were set up across New Zealand, and trials were conducted in collaboration with scientists from other organisations.
31. These trials were conducted using the 2 metre macrocosms described in previous EcoPond reports, following a standard experimental protocol.
32. Effluent and sludge were collected from each farm pond, and 15 litres was then poured into each column. The sludge and effluent were treated with PFS/SA solutions until the redox potential value of the sludge and effluent exceeded +200 mV. Control columns did not treat the sludge and effluent.
33. Each column was then filled with fresh dairy effluent. Methane emissions were measured by attaching gas tight caps onto each column. The methane concentration was measured immediately after attaching the gas cap, then at 20-minute and 40-minute intervals. The gas caps were then removed until the next measurement collection. Measurements were repeated weekly.
34. Typical management of the effluent pond was simulated by removing 14 L of effluent from each column and replacing this with 14 L of fresh effluent every week, except during the winter when the cows were dry and there was no fresh effluent.
35. Results of the 10 regional trials can be seen in Table 1. These results demonstrate the relative consistency of the treatment across multiple dairy regions in New Zealand **with an average reduction of 95%** (noting that one trial had to be restarted in Spring 2025 due to technical error).

Table 2: Average Reduction in Methane Emissions in the Regional EcoPond Gen#2 Trials

Trial #	Trial name	Reduction (%)
14	Gen#2 Farm - Northland	86
15	Gen#2 Farm - Waikato	98
16	Gen#2 Farm - Taranaki	97
17	Gen#2 Farm - Manawatū	95
18	Gen#2 Farm - BOP	95
19	Gen#2 Farm – North Canterbury Oxford	96
20	Gen#2 Farm – West Coast ₁	-
21	Gen#2 Farm – Mid Canterbury	97
22	Gen#2 Farm - Otago	93
23	Gen#2 Farm - Southland	98
Average		95

₁ Trial to be restarted in Spring 2025 due to technical error

Seasonal data on Gen#2 efficacy in macrocosms

36. Field trials were conducted in each season to understand the effectiveness of Gen#2 technology throughout the year. The trials used the same 2 metre macrocosms described earlier in this paper.
37. These trials included a simulation of shock dosing of an effluent pond. This involves pumping out the upper 60% of the pond, and the remaining sludge/effluent is shock dosed with EcoPond additives. The columns contained 7.5 litres each of pond sludge and effluent (i.e. total of 15 L).

38. The sludge/effluent mixture was treated with Gen#2 PFS/SA solutions until the redox potential value exceeded +200 mV. Control columns did not receive treatment on the 15 litres of sludge/effluent.
39. Each column was then filled with FDE, to simulate typical 2 metre depth of an on-farm effluent pond. Further simulation of the pond management involved removing 7.5 litres of effluent from each column twice per week and replacing it with fresh effluent. This simulated typical on-farm practises.
40. Methane gas emissions were measured using tuneable diode laser absorption spectroscopy. The results from these trials showed an **average methane reduction of 97%** and consistency of mitigation across seasons (Table 2).

Table 3: Percentage reductions in methane emissions from seasonal trials using EcoPond Gen#2

Trial #	Trial name	Reduction (%)
9	Gen#2 Farm – in Spring #2	95
10	Gen#2 Farm – in Summer	95
11	Gen#2 Farm – in Autumn	97
12	Gen#2 Farm – in Winter (unseparated)	99
Average		97

Proposed changes – Include EcoPond Generation 2 in the inventory.

41. The inventory team propose the following technical approach for accounting for EcoPond in the inventory model.
42. For each treatment the inventory approach requires the following information:
- a. Treatment Date
 - b. Region
 - c. Anonymous Farm ID
 - d. Mature milking cows on farm (it is assumed only effluent from mature milking cows are mixed into ponds treated by EcoPond)
43. Step1: Determine the number of cows treated daily by farm
- I. Each EcoPond treatment is assumed to suppress methane emissions for 42 days (6 weeks)
 - II. For each treatment date, a sequence of daily records is generated to represent the full suppression period.
 - III. These sequences are merged with the original treatment data to create a daily record of cows under treatment.
 - IV. To avoid double-counting, overlapping treatments for the same farm are filtered. Only the most recent treatment for each farm and date is retained.
44. Step 2: Determine the proportion of cows treated by region and month.
- V. Daily counts of cows under treatment are summed by region.
 - VI. These daily values are then averaged by month to produce regional monthly estimates.

- VII. The regional monthly estimates of cows under treatment are used to calculate the proportion of mature milking cows treated per region and month.

45. Step 3: Calculate the effective methane mitigation

- VIII. The following equation is proposed to calculate the adjustment factor to the regional anaerobic lagoon methane emissions each month:

$$EcoPond\ mitigation = Proportion\ cows\ treated \times EcoPond\ Efficacy$$

Where:

$EcoPond_{mitigation}$ = Impact of EcoPond by region and month

$Proportion\ cows\ treated$ = Proportion of mature milking cows contributing to treated ponds

$EcoPond\ Efficacy$ = 92% reduction in methane from anaerobic lagoons when treated

46. This mitigation factor is then applied to the methane from anaerobic lagoons

$$CH_{4AL-dairy} = FDM \times (1 - ASH) \times B_0 \times 0.67 \times MCF \times MS_{AL,CH_4} \times (1 - EcoPond_{mitigation})$$

Where:

$EcoPond_{mitigation}$ = Impact of EcoPond

$CH_{4AL-dairy}$ = methane per dairy animal from anaerobic lagoons per day (kg)

FDM = kilograms of faecal dry matter per animal per day

ASH = Ash content of manure, assumed to be 0.08 (IPCC default value)

B_0 = Maximum methane-producing capacity of manure, 0.24 (IPCC, 2006)

$MCF=$ Methane conversion factor, 0.74 (IPCC, 2006)

$MS_{AL,CH_4}=$ Fraction of total annual dairy manure excreted in anaerobic lagoons

Proposed change – summary

47. The suggested parameters for including EcoPond Gen#2 treatment in the inventory are:
- A 92% reduction in methane from anaerobic lagoons when treated, and
 - A 6-week efficacy period.
48. The capstone trial demonstrated a strong reduction in methane emissions (91–94%), with each treatment lasting 6 to 9 weeks. While additional field trials have been conducted, the variation observed between those results and the capstone trial have not been fully explained. On that basis, and given the primacy of the capstone findings, we are proposing to use a 92% efficacy. This is the mean value of the three treatments in the capstone trial.
49. Results from the wider regional and macrocosm experiments indicate that EcoPond Gen#2 treatment could reduce methane emissions from farm dairy effluent by an average of 95% (S.E. = 1%), regardless of season or region tested.
50. Ravensdown have informally agreed to supply the inventory with the data required to account for EcoPond technology. The inventory team are working on an MoU to formalise this arrangement.
51. From the suggested activity data and efficacy, a region-specific impact (*EcoPond_{mitigation}*) will be calculated. This will be applied to reduce the methane estimated from anaerobic lagoons.

Opportunities and risks

52. All research carried out via the Greenhouse Gas Inventory Research (GHGIR) Fund is done for the direct purpose of increasing the accuracy of reported emissions. Undertaking this research provides us with the opportunity to increase the accuracy of reported agricultural emissions by adopting the findings within the inventory model.
53. This approach is a departure from the standard inventory process as we are anticipating the uptake of the EcoPond technology. Usually, we would make a change to improve the accuracy of the inventory in the present, but this change is aiming to equip the inventory to report accurately in the future when the technology may be more popular.
54. The inclusion of a mitigation technology in the inventory could attract additional scrutiny to the inventory as it is novel.
55. We are relying on Agnition for the activity data for this process. As Agnition owns the IP of this technology the data could be perceived as biased and may reduce the perception of the independence of the inventory. This also sets a precedent for data supply for future mitigations. There is an opportunity to improve how information on mitigation technology use is captured as use becomes more common. Ravensdown have assured the inventory team that their data are auditable for inventory purposes.

Next steps

Two options are proposed:

Option A – Include EcoPond Generation 2 (Capstone based) Recognise the significant impact of EcoPond Generation 2 on reducing emissions from anaerobic lagoons when treated following the SOP.

Adopt the proposed methodology for including EcoPond Generation 2 in the inventory, including a 92 percent mitigation factor for treated effluent and a 6-week efficacy period.

Review the methodology and assumptions after 12 months of operational data to confirm performance and make any necessary adjustments.

If the Panel recommends the adoption of Option A, this recommendation will go to the Deputy Director-General (Policy and Trade) and the Reporting Governance Group for approval to include in the 2025 Inventory.

Lincoln University is conducting further research on EcoPond. If this new research shows the use of EcoPond has different efficacy and effective duration than proposed in option A, the Inventory team will seek a recommendation at a future Advisory Panel Meeting to adopt these new values, along with changes to the SOP.

Recommendations

It is advised that the Agricultural Inventory Advisory Panel:

Recommend including the proposed methodology, emission factor and efficacy duration for including EcoPond Generation 2 in the inventory, as outlined in Option A.

Agree Option A

Approved/ Not Approved/ Approved as Amended



Gerald Rys

Principal Science Advisor, Office of the Chief Dept Science Adviser
Chair, Agricultural Inventory Advisory Panel

3/2/26

UNCLASSIFIED

UNCLASSIFIED

References

Cameron K, and Di H. 2025. EcoPond Generation #2 results: *Report to the MPI Agricultural Inventory Advisory Panel*. Centre for Soil & Environmental Research, Lincoln University.

Clough T, Cameron K, and Di H. 2024. *The case for including EcoPond Generation 2 in the New Zealand Greenhouse Gas Inventory as a methane mitigation tool for dairy cattle manure management*. Report for Ministry for Primary Industries (unpublished).

Appendix One – Standard Operating Procedure

[Redacted]

Appendix Two – Clarification on Tables 3 and 4

In table 3 (page 30) what does IBC mean?

- IBC is the abbreviation for an 'Intermediate Bulk Container'. Each IBC holds 1,000L of liquid. We used these to give us replication of treatments and as a scale model of a 1 million litre effluent pond.

Can I check I have interpreted table 4 correctly? Table 4 is a more detailed analysis of the 'mature' trials listed in table 3? What does 'mature' in this context mean?

- Table 3 contains summary information about all the EcoPond Gen#2 trials, whilst Table 4 contains a more detailed analysis of the 'mature' trials.
- Each trial listed in Table 3 may have received multiple treatments throughout its duration. Therefore, to provide information on the effectiveness and longevity of individual EcoPond treatments, the trials from Table 3. were further delineated into the individual treatment results in Table 4. In this context 'mature' simply means that the trial has run for long enough to give reliable information about the effectiveness and longevity of its individual treatments.

Table 4 doesn't have information on trials 1, 2, 3, 4, 8, 13, 14, 20, and 21. I presume that this means these trials were not mature?

- Yes, and some more specific reasons are:
 - **Trials 1-4** were exploratory studies that were conducted early in the EcoPond Gen#2 program. Various aspects (e.g. dose rates/frequencies, lack of fresh effluent exchange, etc) of those early trials made it too early for data to be included in Table 4.
 - **Trial 8** (labelled Spring 1) was the first column study in the Seasonal Trials and although it used Gen#2 treatments (PFS & SA) it was run without exchanging fresh effluent – the trial was therefore repeated with effluent exchange as Trial 9 (labelled as 'Spring#2'). Importantly, both trials show similar average methane reductions of 99 and 95%. Thus, confirming that the 'shock dosing' of the sludge/effluent is key to reducing methane emissions regardless of whether fresh effluent is added or not.
 - **Trial 13** (labelled 'separated effluent') was run in parallel with Trial 12 Winter (unseparated). It compared the effect of EcoPond treatment on 'separated effluent', which is a special case where a farm may use a rotary screen separator to remove large pieces of organic matter, stones, etc. before the effluent goes into the pond. Because the results from the separated and unseparated effluent trials were the same, we only added one of those trials (Trial 12) into the statistical analysis in Table 4.
 - **Trial 14** data was too early to be included in the mature trials in Table 4. Data from this trial will be included in Table 4 in future.
 - **Trial 20** had a technical issue at the start and has been restarted, so data from this trial will be included in Table 4 in future.

How do the trial durations link between table 3 and 4? Some of the durations in table 4 add to the values in table 3, but some don't.

- Table 4 considered only treatments which were sufficiently 'mature'. If for example a trial was treated on Day 0, Day 60 and Day 100, and it is now day 109. The first two treatments would be included, but the Day 100 treatment wouldn't be, because it has

only been running for 9 days. Thus, the sum of included treatment durations (60 days + 50 days) \approx the trial duration (109 days).