<table>
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<th><strong>Title</strong></th>
<th>Full inversion tillage renewal to increase soil carbon: agronomic and environmental benefits and trade-offs</th>
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<td><strong>Project Timeframe</strong></td>
<td>Aug 2017 – Sep 2020</td>
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| **Countries Involved** | New Zealand (The New Zealand Institute of Plant and Food Research, Manaaki Whenua-Landcare Research, Massey University)  
Ireland (Teagasc, Trinity College Dublin)  
Germany (Thunen Institute) |
| **Aim** | To verify the potential to increase soil carbon and to demonstrate the practical applications of full inversion tillage (FIT) pasture renewal, including its effects on the agronomic and environmental performance of pasture systems. |
| **Research Highlights** | • Modelling indicated that FIT pasture renewal could sequester 21-36 Mt C across 2.6 Mha of New Zealand high production grassland soils (suitable for ploughing) over 20 years. This is approximately 10-17% of New Zealand’s agricultural GHG emissions over the same period (at current emissions rates).  
• The additional costs of FIT pasture renewal (tillage and fertiliser) were offset by higher dry matter production within the first 12-18 months following pasture renewal (compared with non-renewed pasture), particularly where a forage crop was grown as a break between old and new pasture.  
• N2O emissions (winter-spring period) from livestock urine patches on FIT pastures are 30-40% lower than the emissions on continuous (non-renewed) pasture and 50-60% lower than emissions on pasture renewed with no-tillage  
• FIT pasture renewal also reduced the risk of nitrate leaching compared with no-tillage pasture renewal but under certain circumstances.  
• Practical guidelines for FIT pasture renewal were developed, covering aspects like suitable soils/sites, tillage, nutrient management, and seasons (autumn vs spring).  
• International collaborations were made with Ireland, Germany and Ireland. |
| **Future Work** | • Further research is required to verify the benefits for GHG mitigation and to support on-farm adoption.  
• Establish demonstration trials on farms representing a range of suitable soils and climates to test and improve the good management practice guidelines and to monitor the longer-term gains in soil carbon and agronomic performance. |
- Verify the reductions in N₂O emissions during pasture re-establishment and from urea fertiliser and livestock urine applied to different soils.
- Identify the biogeochemical mechanisms that are responsible for increasing soil C storage following FIT pasture renewal in order to maximise the benefits across different soils and climates.

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<th>Key Research Output(s)</th>
<th>Journal articles</th>
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|                       | Madigan, A.P., Zimmermann, J., Krol, D.J., Williams, M., Jones, M.B. (Under Review) Full Inversion Tillage as a potential future...
| management strategy for enhanced carbon sequestration in Irish grassland soils. *Geoderma.*

**Conference proceedings/presentations**

33. Farmed Landscapes Research Centre, Massey University, Palmerston North, New Zealand. 7 pages.


Calvello Pereira, R., Hedley, M.J., Hanly, J., Osborne, M., McNally, S.R., Beare, M.H. The agronomic and environmental benefits and risks of spring pasture renewal with full inversion tillage. 33rd Annual Fertiliser and Lime Research Centre Workshop, entitled:


McNally, S.R., Beare, M.H., Tregurtha, C., Gillespie, R., Lawrence-Smith, E., Van der Klei, G., Thomas, S., Calvelo Pereira, R., Hedley, M. Full inversion tillage offers opportunity for increased C sequestration, implications and agronomic effects. 7th International Symposium on Soil Organic Matter, Adelaide. 6-11 October 2019


Schiedung, M., Tregurtha, C., Beare, M.H., Thomas, S., Don, A. Soil organic carbon sequestration after deep flipping of grassland
| McNally, S., Beare, M.H., Tregurtha, C., Gillespie, R., Lawrence-Smith, E., Calvello Pereira, R., Hedley, M. | Vertical distribution of soil carbon following full inversion tillage: implications for C |


