

**STRATEGIC SCIENCE INVESTMENT FUNDING (SSIF)-
FINAL PROJECT REPORT FOR FY2018**

ESR is fully accountable for Strategic Science Investment Funding (SSIF).

Information in this report will be used to demonstrate the value of ESR SSIF and to quantify the benefit from the investment. It will also inform future investment of SSIF.

Your Final Report is also used to populate the Board Science Report for FY2018/19. Please remember if you don't inform the Research Office we can't inform MBIE or the Board, and your work will not have the impact it deserves.

Please complete and email, in Word Doc form, to [\[Withheld under section 9\(2\)\(a\) of the OIA\]@esr.cri.nz](mailto:[Withheld under section 9(2)(a) of the OIA]@esr.cri.nz) by Friday 12th July 2019.

Project Title: Centre for Integrated Biowaste Research (CIBR)

Project Leaders: Maria J. Gutierrez Gines (CIBR) & Louise Weaver (CIBR – Pathogen removal in wastewater)

Duration: 2 of 3

Completion of Milestones

Please provide:

#Of Milestones in the project [29]

#Of Milestones COMPLETED [14]

#Of Milestones ON TRACK [9]

#Of Milestones BEHIND [5]

Our goal for SSIF investments for FY2018 was to increase ESR capabilities and impact across our four key areas (forensics, food, health and water). Please provide details on HOW your SSIF project contributed to:

1. Developing our capability in areas of national importance

- The social team furthers our collaborative exploration of new models of indigenous knowledge building/science education/community engagement for sustainable change, allowing the knowledge of the team to be more widely known.
- Successful bid to investigate the impacts of microplastics in NZ by Olga Pantos (ESR) and Grant Northcott (Northcott Research Ltd).
- Antimicrobial resistance (AMR) in wastewater and looking at improved treatment options to reduce the impact of AMR on the environment, using whole metagenome analysis. This led to further applications for funding to develop methods for detecting AMR genes in wastewater, which were successful - "AMR in Wastewater" – *[Withheld under section 9(2)(a) of the OIA]*, and Louise Weaver. ESR-SSIF funding.
- Method for testing biosolids contaminants on key ecological species, especially transcriptomic protocol for investigation of contaminants in biosolids against springtails.
- The development of a joint Australia-Aotearoa (New Zealand) framework to manage pollutants in Australasia. This knowledge is being put together to assess and manage the risks associated with the presence of chemical contamination in our environment is being run by the ecotoxicology and social and cultural research team members.
- Developing deeper international collaborations with China, which could lead to new research projects.
- Exploring research collaboration with Chile, about the reuse of biosolids into land, and Spain, about resource recovery from wastewater, restoration and conservation of degraded soils with biowaste, and reuse of biowaste into agriculture.
- Establishment of five permanent field trials, as a scientific resource for the long-term investigation of biowaste and NZ native vegetation.
- Supporting future scientists by PhD and Masters studies in collaboration between CIBR teams and with external entities.

2. ESR's impact for New Zealand

- Give effect to Vision Mātauranga in work related with holistic views of environment and sustainable behaviour, management of waste, collaborative governance of environmental issues.
- Provide science based support for reducing the disposal of biowaste, and finding optimal reuse options for the best cultural, social, economic and environmental outcomes.
- Provide science and knowledge about risks of emerging contaminants, and antimicrobial resistance in the NZ fragile environment and public health.
- Recovering NZ native ecosystems in degraded environments, such as mine areas, biowaste disposal fields, and intensive agricultural areas.
- Increasing the visibility of NZ science and research into the international landscape.

List the external research or grant proposals submitted (include \$ value) and any research funding obtained that have been made possible as a result of SSIF investment in the project; include proposals awaiting funding decisions:

1. "Impacts of microplastics on New Zealand's bioheritage systems, environments and ecoservices" Olga Pantos (ESR) and Grant Northcott (Northcott Research Consultants). MBIE endeavour fund - \$12,536,205 over five years. **Successful.**
2. [Withheld under section 9(2)(b)(ii) of the OIA] **Unsuccessful.**
3. [Withheld under section 9(2)(b)(ii) of the OIA] **Unsuccessful.**
4. [Withheld under section 9(2)(b)(ii) of the OIA] **Submitted.**
5. [Withheld under section 9(2)(b)(ii) of the OIA] **Submitted, at stage 2.**
6. [Withheld under section 9(2)(b)(ii) of the OIA] **Unsuccessful.**
7. [Withheld under section 9(2)(b)(ii) of the OIA] **Unsuccessful.**
8. "AMR in Wastewater" – [Withheld under section 9(2)(a) of the OIA], and Louise Weaver. ESR-SSIF \$199,673. **Successful**

List the **1) peer reviewed publications, 2) conference presentations (oral) 3) conference presentations (poster), 3) external presentations other than conference developed from this SSIF project:**

Peer reviewed publications

1. **Gutiérrez-Ginés MJ, Madejón E, Lehto NJ, McLenaghan RD, Horswell J, Dickinson N, Robinson BH.** 2019. Response of a Pioneering Species (*Leptospermum scoparium* J.R.Forst. & G.Forst.) to Heterogeneity in a Low-Fertility Soil. *Frontiers in Plant Science*. 10:93. doi: 10.3389/fpls.2019.00093
2. **Saleeb N, Robinson B, Cavanagh J,** Mofasser AKM, Gooneratne R 2019. Biochemical changes in sunflower plant ex-posed to silver nanoparticles/silver ions. *SDRP Journal of Food Science & Technology* 4(2): 629-644. DOI: 10.25177/JFST.4.2.RA.469
3. **S. Seyedalikhani, J. Esperschuetz, N.M. Dickinson, R. Hofmann, J. Breitmeyer, J. Horswell, B.H. Robinson.** 2019. Biowastes to augment the essential oil production of *Leptospermum scoparium* and *Kunzea robusta* in low-fertility soil. *Plant Physiology and Biochemistry*. Volume 137, 213-221. <https://doi.org/10.1016/j.plaphy.2019.02.008>.
4. **Saleeb N, Gooneratne R, Cavanagh JE, Bunt C, Mofasser-Hossain AKM, Gaw S, Robinson BH** (2019). The mobility of silver nanoparticles and silver ions in the soil-plant system. *Journal of Environmental Quality*. In press. doi: 10.2134/jeq2019.03.0098.
5. **Jensen H, Orth B, Reiser R, Buerge D, Lehto N, Almond P, Gaw S, Thomson T, Lilburne L, Robinson BH** (2019). Environmental parameters affecting the concentration of iodine in New Zealand pasture. *Journal of Environmental Quality*. In press. doi: 10.2134/jeq2019.03.0128

6. Benyas E, Owens J, **Seyedalikhani S, Robinson BH** (2018). Cadmium uptake by ryegrass and ryegrass-clover mixtures under different liming rates. *Journal of Environmental Quality* 47(5), 1249-1257.
7. **Jensen H, Gaw S, Lehto NJ, Hassall L, Robinson BH** (2018). The mobility and plant uptake of gallium and indium, two emerging contaminants associated with electronic waste and other sources. *Chemosphere* 209, 675-684.
8. **Charry MP, Northcott GL, Gaw S, Keesing V, Costello MJ, Tremblay LA**. 2019. Development of acute and chronic bioassays using the pelagic copepod *Gladioferens pectinatus* to assess estuarine health. *Ecotoxicology and Environmental Safety*. 174: 611–617.
9. Guyon A, Smith KF, **Charry MP, Champeau O, Tremblay LA**. Effects of chronic exposure to benzophenone and diclofenac on DNA methylation levels and reproductive success in a marine copepod. In press in *Journal of Xenobiotics*.
10. **Charry MP, Wells JBJ, Keesing V, Smith KF, Stringer TJ, Tremblay LA**. *Quinquelaophonte aurantius* sp. nov., a new harpacticoid species (Copepoda: Harpacticoida: Laophontidae: Quinquelaophonte) from New Zealand. *New Zealand Journal of Zoology*. DOI: 10.1080/03014223.2018.1548496
11. **Tremblay LA, Booth L, Cavanagh JE, Champeau O, Northcott GL, Cedergreen N**. The effects of the mixtures of three micro-contaminants commonly found in biosolids on earthworm reproduction. In press in *The Australasian Bulletin of Ecotoxicology and Environmental Chemistry*.
12. Feng, C-Q, Cheng, D-M, Feng, Y, W-N, Jia, Z-H, **Weaver, L**, Liu, Y-W, Li, Z-J. 2019. Screening and degradation characteristics of a tylosin degrading bacterial strain. *Journal of Integrative Agriculture*. In Press.
13. Feng, Y., Zhang, W.J., Liu, Y.W., **Xue, J.M.**, Zhang, S.Q., Li, Z.J. 2018. A simple, sensitive, and reliable method for the simultaneous determination of multiple antibiotics in vegetables through SPE-HPLC-MS/MS. *Molecules* 23 (8), 1953.; doi:10.3390/molecules23081953
14. Cheng, D., Feng, Y., Liu, Y., Li, J., **Xue, J.M.**, Li, Z. 2018. Quantitative models for predicting adsorption of oxytetracycline, ciprofloxacin and sulfamerazine to swine manures with contrasting properties. *Science of the Total Environment* 634, 1148–1156.
15. Gallart, M.; Adair, K.L.; Love, J.; Meason, D.F.; Clinton, P.W.; **Xue, J.M.**; Turnbull, M.H. 2018. Genotypic variation in *Pinus radiata* responses to nitrogen source are related to changes in the root microbiome. *FEMS Microbiology Ecology*, 94 (6), fiy071, <https://doi.org/10.1093/femsec/fiy071>
16. Liu, Y, Feng, Y, Cheng, D, **Xue, J.M.**, Wakelin, S A, Li, Z. 2018. Dynamics of bacterial composition and the fate of antibiotic resistance genes and mobile genetic elements during the co-composting with gentamicin fermentation residue and lovastatin fermentation residue. *Bioresource Technology* 261, 249-256. August 2018

17. Zhang, C., **Xue, J.M.**, Cheng, D., Feng, Y., Liu, Y., Aly, H. M., & Li, Z. 2019. Uptake, translocation and distribution of three veterinary antibiotics in *Zea mays* L. *Environmental Pollution*. <https://doi.org/10.1016/j.envpol.2019.03.110>
18. Weining Qi, Jian Long, Changqing Feng, Yao Feng, Dengmiao Chen, Yuanwang Liu, **Jianming Xue**, Zhaojun Li 2019 Fe³⁺ enhanced degradation of oxytetracycline in water by *Pseudomonas*. *Water Research*, <https://doi.org/10.1016/j.watres.2019.05.058>
19. Yang, L., He, L., **Xue, J.M.**, Wu, L., Ma, Y., Li, H., Peng, P., Li, M., Zhang, Z. Highly efficient nickel (II) removal by sewage sludge biochar supported α -Fe₂O₃ and α -FeOOH: Sorption Characteristics and Mechanisms. *PLOS ONE* (accepted).
20. Cheng, D., Feng, Y., Liu, Y., **Xue, J.M.**, Li, Z. 2018. Dynamics of oxytetracycline, sulfamerazine, and ciprofloxacin and related antibiotic resistance genes during swine manure composting. *Journal of Environmental Management*. 29 Sep 2018. doi: 10.1016/j.jenvman.2018.09.074.
21. Angus Macfarlane, Richard Manning, **Jamie Ataria**, Sonja Macfarlane, Melissa Derby, Te Hurinui Clarke. (2019). Wetekia kia rere: the potential for place-conscious education approaches to reassure the indigenization of science education in New Zealand settings. *Cultural Studies of Science Education*, <https://doi.org/10.1007/s11422-019-09923-0>
22. **Richard T. Yao, E.R. (Lisa) Langer, Alan Leckie, Louis A. Tremblay**, Household preferences when purchasing handwashing liquid soap: a choice experiment application. *Journal of Cleaner Production*. Accepted: DOI: 10.1016/j.jclepro.2019.07.002

Conference presentations (oral)

1. **Clemens, H., Weaver, L.**, Morgan, L. Virus removal through on-site septic tank disposal fields. Presented by Hazel Clemens at *Water NZ conference*, Hamilton, September 19-21 2018.
2. Garnett, A., **Villanueva S.**, Adding clarity to the murky world of greywater re-use and risk to human health. Co-presented by Amber Garnett (BRANZ) and Sein at *Water NZ conference*, Hamilton September 19-21st 2018.
3. **Louis Tremblay**, Rick Van Dam, **Jacqui Horswell**. 2018. Considerations for water quality guidelines for emerging contaminants. A talk presented at the *50th NZ Freshwater Science Society Conference*, 10-14 December, Nelson.
4. **Xue, J.M.** and Kimberley, M. 2018 Long-term application of biosolids enhanced soil fertility and carbon sequestration of radiata pine plantation on a marginal land. In the proceedings of the *4th International Congress on Planted Forests* in Beijing, China on 23-26 Oct 2018.
5. **Xue, J.M.**; Kimberley, M.; Wang, M.H.; **Gielen, G.**; **Tremblay, L.A.**; Champeau, O.; C. Ross, C.; Horswell, J. 2018 Beneficial use of biosolids to forestland: What are the environmental impacts? In the proceedings of the *New Zealand Soil Science Conference* in Napier, on 3-6 Dec. 2018.
6. **Xue, J.M.**; Kimberley, M. 2018. Repeated application of biosolids improved soil fertility, tree growth and carbon sequestration of radiata pine plantation on a marginal land. In the proceedings of the *New Zealand Soil Science Conference* in Napier, on 3-6 Dec. 2018

7. **Gutierrez-Gines MJ, Simcock R, Xue J, Horswell J, Langer L, Madejón E, McLenaghan RD, Letho N, Dickinson N, Robinson BH.** 2019. Biosolids for rehabilitation of NZ degraded land. Oral presentation. *Biosolids National Conference 2019. Biosolids in the Circular Economy.* 21-22 February 2019, Brisbane, Australia
8. **M.J. Gutierrez-Gines, C. Sitz, S. Halford, I. Alderton, J. Horswell, S. Cass, B. Robinson, G. Northcott, H. Lowe.** 2019. Where is my phosphorous? – 30 years of treated effluent land application. Oral presentation in *New Zealand Land Treatment Collective Conference.* Invercargill 3-5 April 2019
9. **Maria J Gutierrez Gines, S. Halford, A. Meister, I. Alderton, V. Ambrose, S. Villanueva, J. Prosser, B. Robinson, J. Horswell.** 2019. Mānuka Is Not Alone In Its Antimicrobial Potential. Oral presentation in *New Zealand Land Treatment Collective Conference.* Invercargill 3-5 April 2019.
10. **Grant Northcott, Louis Tremblay, Jacqui Horswell** –AMR the New Zealand Perspective. *What's In Our Water Symposium, Society of Environmental Toxicology and Chemistry (SETAC),* 29-31st October, 2018 in Canberra, Australia.
11. **Grant Northcott, Louis Tremblay,** Fred Leusch-Identification of priority emerging organic contaminants in wastewater” *What's In Our Water Symposium, Society of Environmental Toxicology and Chemistry (SETAC),* 29-31st October, 2018 in Canberra, Australia.
12. **Grant Northcott, Louis Tremblay, Jamie Ataria, Jacqui Horswell, Virginia Baker,** Mike Stewart, Fred Leusch, Graham Sevicke-Jones –Research program to manage emerging organic contaminants in NZ” *What's In Our Water Symposium, Society of Environmental Toxicology and Chemistry (SETAC),* 29-31st October, 2018 in Canberra, Australia.
13. **Virginia Baker, Jamie Ataria, Jacqui Horswell, E.R. (Lisa) Langer, Alan Leckie, Joanna Goven,** Rangimarie Parata-Takurua, **Louis Tremblay** – What’s in our water, and what can we do about it? Science at the interface of policy, community and sustainable change. *What's In Our Water Symposium, Society of Environmental Toxicology and Chemistry (SETAC),* 29-31st October, 2018 in Canberra, Australia.
14. **Virginia Baker, Jamie Ataria, Jacqui Horswell, E.R. (Lisa) Langer, Alan Leckie, Joanna Goven,** Rangimarie Parata-Takurua, **Louis Tremblay** (2018) Re-configuring relationships and practice for sustainable change. *45 Society for Social Studies of Science conference: Transdisciplinary theme,* 29 Aug – 1 Sept. Sydney 2018.
15. **V.E. Baker, J. Ataria, J. Horswell, E.R. Langer, A. Leckie** (2018) Schools and community engagement in science: Expanding a sustainable focus. *New Zealand Association for Environmental Education Conference,* 18-20 April 2018, Wellington.
16. **Gutierrez-Gines MJ, Clarke D, Baker V, Alderton I, Simcock R,** Tupuhi G, **Robinson BH,** Taylor M, Efford J, Nikau T, Biddle TR, Moana T, **Horswell J.** 2019. Water Quality, Ecosystem Restoration and Traditional Knowledge. Oral Presentation. *Conference on Land Use and Water Quality. Agriculture and Environment.* 3 – 6 June 2019. Aarhus, Denmark. Volume of Abstracts, pp 24-25.
17. Hernández AJ, Ceballos RM, Tena E, Frías M, **Gutiérrez-Ginés MJ.** 2019. Policies for the good treatment between people, between the two genders, and with the environment in island

territories. *26th APDR Congress. Evidence-based territorial policymaking*. 4 – 5 July 2019, University of Aveiro, Portugal.

18. **Jianming Xue** 2019. Microplastics in soil-plant system and their ecological and environmental impacts. An invited plenary talk presented at the *2nd National Conference on Environmental Pollution and Control of Microplastics*. Nanjing, China 4-6 June, 2019.
19. **Alan Leckie, Lisa Langer**, 2018. Impacts of a natural disaster on a growing town's projected waste planning – biosolids and wastewater system. Oral presentation by Alan Leckie at the *IUFRO Extension and Knowledge Exchange Working Party 09.01.03 Conference*, Christchurch, N.Z. 9-14 September 2018
20. **Brett Robinson** (2019) Keynote speaker at the *International Conference on Environmental Science and Resource Management*, Tangail, Bangladesh, 8 February.
21. **Louis Tremblay, Olivier Champeau, Grant Northcott**, Kevin Simon. 2019. Assessing the risk of microplastics in New Zealand. An invited keynote talk presented at the 2nd Conference on National Environmental Pollution and control of microplastic. Nanjing, China 4-6 June.
22. **Louis Tremblay**. 2019. Managing pollutants in New Zealand. An invited talk presented at the Institute of Agricultural Resources and Regional Planning Center of Soils and Fertilizers Research, Chinese Academy of Agricultural Sciences, Beijing, China, 9 June.

Conference presentations (poster)

1. **Villanueva, Prosser, Gutierrez-Gines, Tinholt, Lowe, Horswell**. 2019. Biosolids as growth medium for plants in nurseries. Poster in *New Zealand Land Treatment Collective Conference*. Invercargill 3-5 April 2019.
2. **Villanueva, Prosser, Gutierrez-Gines, Tinholt, Lowe, Horswell**. 2019. Biosolids as growth medium for plants in nurseries. Poster in Biosolids National Conference 2019. Biosolids in the Circular Economy. 21-22 February 2019, Brisbane, Australia

External Presentations

1. **Virginia Baker, Mat Walton, Jamie Ataria, Jacqui Horswell, E.R. (Lisa) Langer, Alan Leckie, Joanna Goven, Louis Tremblay**. (2018) Getting beyond behaviour change: Combined systems thinking and social science approaches for complex environmental problems. Invited workshop, hosted by BRANZ at the Royal Society NZ, 6 August 2018, Wellington.
2. **V. E Baker, J. Ataria, L. Tremblay, G. Northcott**, G. Sevicke-Jones, O. Pantos. Managing the risk of Emerging Organic Contaminants (EOCs) in Aotearoa New Zealand's marine ecosystems – Transdisciplinary science approaches for complex environmental problems. Special session workshop: NZ Marine Sciences Society Conference, 3-5 July 2018, Napier.
3. **Jianming Xue 2019**. Beneficial use of biosolids to forestland: What are the environmental and ecological impacts? An invited presentation at the Institute of Soil Science, Chinese Academy of Sciences in Nanjing, China on 4 June 2019.
4. **Jianming Xue 2019**. Ecosystem responses to long-term application of biosolids to a pine forest in New Zealand. An invited a keynote speaker for the Forest Ecosystem Workshop at Beijing Forestry University on 11-14 June 2019.

5. **Gutierrez-Gines MJ.** 2019. Research of Organic Waste in NZ. Seminar at CIEMAT, Spain. 20th may 2019.
6. **Gutierrez-Gines MJ.** 2019. CIBR, 10 years of biowaste research in NZ. Seminar at EIADES, Spain. 17th May 2019.
7. **Gutierrez-Gines MJ.** 2019. The Centre for Integrated Biowaste Research in NZ. Seminar at IRNAS, CSIC, Spain. 22nd may 2019.
8. **Gutierrez Gines, MJ.** 2019. Plant-Soil interactions and remediation of degraded land. Lecture for university students in EcoQuest Education Foundation, Kaiaua, 4th march 2019.
9. **Robinson BH.** 2019 Trace element fluxes in the soil-plant system. Lecture at North Western Agriculture and Forestry University, Yangling, China. 26th June, 2019.

Executive summary – Three to four sentences giving an overview of your project and the results obtained. This will be used for the Board Report so keep in mind that not everyone is an expert in your field.

The Centre of Integrated Biowaste Research (CIBR) is a virtual research centre with transdisciplinary expertise, led by ESR, and composed of Maanaki-Whenua/Landcare Research, Scion, Cawthron Institute, University of Canterbury, Northcott Research Consultants, Kukupa Research, Massey University, NIWA, and Lowe Environmental Impact. The goal of CIBR is to investigate unique and holistic solutions for the sustainable management of biowastes (organic waste), by delivering value-added science that improves human well-being and protects the environment.

In the past year (July 2018 - June 2019), CIBR has demonstrated its success by:

- delivering internationally recognized research, by publishing **22 papers** in international peer reviewed scientific journals, giving **24 presentations** in national and international conferences, and being invited to give 8 presentations, publications and outreach activities, published two newsletters, and refreshed the content in the webpage.
- **attracting \$12,736,000 in research funds** for increasing our capability on microplastics research and developing methods for detecting AMR genes in wastewater.
- keeping working collaborations with **18 regional and district councils**, and **six iwi groups**.
- having **13 successful students**: four master students and seven PhD students, and two interns, and other **13 ongoing students**.
- investigated **Māori worldviews of kaitiakitanga**/guardianship, and values of whānau (family), whakapapa (genealogy), and tikanga (tradition) in designing opportunities to reuse and minimise biowastes.
- establishing **five permanent field trials** which will be an important scientific resource for the team for investigating long-term effects of biowaste and restoration of NZ native species.
- being acknowledged for our expertise by participating in the **revision of the national guidelines** for the land application of organic waste.

- extending our capabilities by increasing longstanding collaborations with research institutes in **China, Australia, UK, Spain, Chile, and Bangladesh.**

Project report –Include brief background, what you did, what you found, conclusions (max 2 pages). This is the opportunity to tell a success story that ESR can use in Impact Case Studies, Briefing and other communications

The CIBR group has continued to develop the necessary work for investigating unique and holistic solutions for the sustainable management of biowastes (organic waste), which improves human well-being and protects the environment. In particular, CIBR's work has been focused on three main streams: i) deliver cutting-edge science regarding the beneficial reuse of biowaste, ii) to inform environmental and public health decision making in New Zealand, iii) increase our capabilities and grow our science by increasing our international and national collaborations, and attracting new research, and bringing new students.

Delivering valuable science

The group has continued its successful research with further developments in these areas, particularly developing methods for analysing emerging contaminants and their ecotoxicity, investigating beneficial reuse of biosolids, greywater, the long-term Rabbit Island Field trial, mānuka and native plants for reducing the impacts of biowaste land application, and a robust social and cultural program. These projects span multiple research streams within CIBR (Soil Science, Microbiology, Ecotoxicology, Social and Cultural). Several research projects are emerging that have strong future potential with significant collaborative opportunities and high likelihood of bringing in more revenue for the group.

We have successfully collected and transcribed information regarding **Māori worldviews of sustainability and kaitiakitanga**, and how to translate those values into day to day sustainability and education practices. The school Te Pā in Ōtautahi (Christchurch) has become a living example of holistic sustainable behaviour. We are developing **ecotoxicity tests** to evaluate the potential environmental risks of emerging organic contaminants in NZ native species, using cutting edge transcriptomic techniques. Rabbit Island's experiment is still producing exciting results about **the long term benefits and potential risks of biowaste** application into forestry, regarding organic contaminants, trace elements, and carbon sequestration in soil and biomass. **NZ native vegetation** is gaining great attention due to their potential antimicrobial properties, economic revenue, and for restoration of NZ's fragile biodiversity using biowaste. Regarding this, we have conducted three greenhouse experiments, and one field experiment, with one lysimeter experiment and one field experiment still ongoing. We have now five field trials established around the country evaluating the role of NZ vegetation for treating biowaste and farm run-off: Waikare, Wairarapa, Levin, Duvauchelle, and Stockton Mine. We are running laboratory experiments to investigate the **enzyme activity in wastewater to reduce emerging organic contaminants**. We are also starting to investigate the presence of **AMR in wastewater** and potential reduction by enzymes.

We have communicated the results in **22 peer-reviewed papers** - and two more are planned for journal submission - **24 conference proceedings** in national and international conferences and

workshops, and have been invited to give lectures and science talks. We shared our knowledge with general public and stakeholders via two CIBR newsletters and the CIBR webpage. We have appeared in the media in numerous occasions. We are working closely with **18 regional and district councils**, and six iwi groups.

Increase our capabilities and grow our science

The CIBR team realises the importance of growing our research and capabilities to be able to deal with imminent challenges in NZ. We have been growing our capabilities in **Vision Mataranga** by exploring and understanding new models of indigenous knowledge for sustainable change, allowing the knowledge of the team to be more widely known. We are developing new **transcriptomic** methods for assessing ecological impacts of contaminants in NZ native species, methods for **sampling and analysing groundwater samples** for residual contaminants, and genomic methods for detecting **Antimicrobial resistance (AMR) in wastewater**.

We have submitted four research applications – MBIE programs, Smart Ideas, Marsden, SSIF – which will grow our research with extra **\$12,700,000**, for growing our capabilities and science in **microplastics** and detection of **antimicrobial resistance genes** in wastewater.

We are extending our capabilities by increasing longstanding collaborations with research institutes in **China, Australia, UK, Spain, Chile, and Bangladesh** and new Māori organisations.

We are strongly **investing in future scientists** by supporting PhD, master and intern students, who have been working and enhancing collaboration between CIBR teams and external institutions:

Successful students:

1. *[Withheld under section 9(2)(a) of the OIA]*
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Current students

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Science for Communities

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