Issue No.6 Summer 2013

Putting waste to work

A CENTRE FOR INTEGRATED BIOWASTE RESEARCH PUBLICATION

Inside this issue

Centre for Integrated Biowaste Research

ESR

Update from the Programme Manager

Welcome to the final newsletter of 2013. It is hard to believe that another year is drawing to a close. The time has flown by and we have made significant progress towards our research goals this year. Below I have outlined some of our key achievements this year.

We wrapped up both our case studies this year and are now concentrating on writing up the results for publication.

Kaikōura District Council CEO Stuart Grant invited Lisa Langer, Alan Leckie, and Jamie Ataria to present the Kaikōura case study community engagement report with recommended biosolids reuse options to the Kaikōura District councillors. The councillors unanimously accepted the CIBR research report and recommendations. This paves the way for the Council to implement the research. They will follow the community's recommendations and apply the 1500 tonnes of stockpiled biosolids to the Clarence forest and native plantings. This shows uptake of four years of integrated CIBR biophysical, social, economic and cultural research and impact within. The full report into the study undertaken in Kaikōura is freely available on the CIBR website, www.cibr.esr.cri.nz.

On the 14th of August, CIBR collaborators from ESR, Scion, Landcare Research and Whenua.biz participated in a final hui with the Mokai community, Tirohanga School and representatives of Environment Waikato, Taupo District Council, and MfE. Information on the vermicomposting work carried out by the team was presented as well as the social and cultural research outcomes. A real highlight were presentations by the students from Tirohanga school who presented their work on how to look after your septic tank, how to save water, and an experiment exploring the impacts of a 'good' and 'bad' quality greywater on plant growth.

This year we also held a joint Australia/New Zealand Biosolids workshop in Blenheim that brought together members of the wastewater industry with researchers to discuss, understand, and debate biosolids reuse. We intend to hold another workshop, 'Advancing resource recovery and reuse of biowaste', once again preceding the New Zealand Land Treatment Collective Annual Conference, on the 25th March 2014, at the Novotel in Hamilton (*for more information check out page 11*).

At the joint Australia/New Zealand Biosolids workshop, we launched our new research centre, the Centre for Integrated Biowaste Research (CIBR). Led by ESR, CIBR is a multidisciplinary collaboration based on a partnership between Scion, Cawthron, Landcare Research and 10 New Zealand research institutes, universities and research partners. The CIBR is dedicated to developing appropriate and sustainable solutions for reusing biowastes.

A highlight for us this year was renewing our links with WasteMINZ, the largest representative body of the waste and resource recovery sector in New Zealand. Jinny Baker and I attended the annual conference in Rotorua in October and presented an overview of the CIBR programme. The conference was brilliant with amazing keynotes such as Mai Chen and Nigel Latta. We made some excellent network linkages and look forward to working with WasteMINZ in the

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Update from the Soil Science Team – Beneficial effects of biosolids application on soil fertility, tree nutrition, and growth of radiata pine on a poor site. *By Jianming Xue*

The CIBR soil science team has been furthering its research on the long-term biosolids trial at Rabbit Island to develop sustainable land application of biosolids for the Nelson community. This long-term research trial is designed by Scion with financial and in-kind support from the forestry management company PF Olsen and Nelson City Council, and provides indicative research findings for land application of biosolids throughout New Zealand.

Biosolids are rich in organic carbon and nutrients. Reuse of biosolids as a supplemental fertiliser and soil amendment is one of the most common options for biosolids management. In New Zealand, application of biosoilds on forest land is generally preferred to application on agricultural land because it can reduce the risk of contaminants entering the human food chain. It can also increase tree growth and subsequent economic returns on marginal land – this is very beneficial as poor soil is an important biophysical constraint.

Since the mid 1990's, a *Pinus radiata* plantation growing on a sandy, low fertility soil at Rabbit Island in Nelson has received aerobically digested liquid biosolids. A research trial was established on the site in 1997 to investigate the long-term effects of biosolids application on soil and groundwater quality, tree nutrition and growth. Biosolids have been applied to the trial site every three years since 1997 at three application rates: 0 (Control), 300 (Standard) and 600 kg N/ha (High). Tree nutrition status and growth are monitored annually, soil properties every three years, and groundwater quality quarterly.

Biosolids application significantly increased foliar N concentration, tree stem volume growth and total forest C stocks (data not shown). In July 2013 when the trees were aged 22 years, the stem volume was 27% and 21% greater in the High and the Standard treatment respectively when compared to the Control

Biosolids application on Rabbit Island

Soil sampling on Rabbit Island

Update from the Programme Manager *continued from front cover*

near future.

The CIBR is teaming up with key waste sector partners, Water New Zealand, WasteMINZ and the New Zealand Land Treatment Collective (NZLTC) to develop a framework for dealing consistently with organic wastes. The aim is to recognise commonalities of organic waste, describe quality criteria for beneficial reuse, increase knowledge and streamline regulatory processes. Led by Nick Walmsley, Technical Director for WaterNZ, this proposed guideline will supersede, update or reference existing guidelines and standards e.g. NZ Biosolids Guidelines, NZS4454 Composting Standard etc. Funding has been secured to initiate work and we are looking forward to making progress on this key initiative next year.

The 'Up-the-Pipe' solutions project also wrapped up this year. The CIBR team has found this project especially rewarding and has really enjoyed working with school children across New Zealand. The team has designed resources for primary and lower secondary schools that provide interactive, effective, and engaging learning opportunities with a range of pedagogies (teaching styles) to promote learning, self-regulation and metacognition. The resources and activities are freely available from ESR and include:

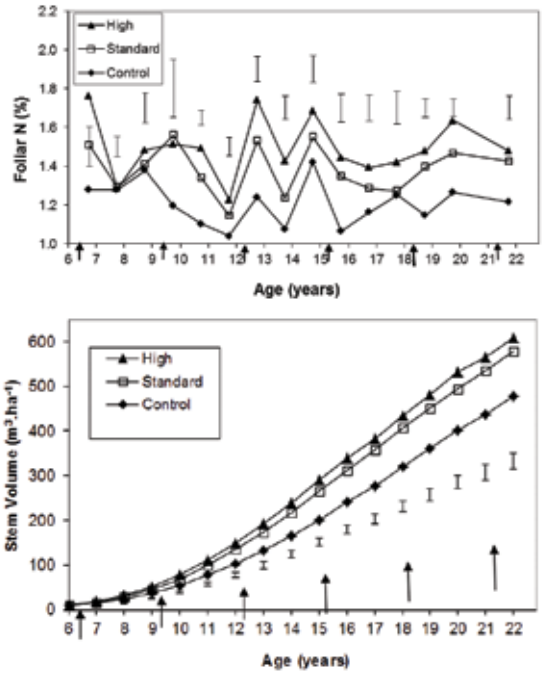
- An ESR water treatment plant video
- 'How many products do we use in our house?' activity
- Making environmentally friendly cleaning products at a science laboratory
- Surveys for students to complete
- Learning about advertising and how it affects people's choices
- An activity on 'Water: where does it come from? How old is it? How much is there?'

I would like to say a very heartfelt thank you to our case study communities in Kaikōura and Mokai. We have really enjoyed working with you and it has been a truly enriching experience for all of us. We hope that you have found our research useful and that we can work together again in the future.

Thank you to all our collaborators and research partners for their invaluable contribution to this research programme, and I hope that you have an enjoyable festive season.

Very best wishes for the New Year. ***Jacqui Horswell***

treatment. Both the Standard and High treatments significantly increased soil total C, N, and P, Olsen P and cation exchange capacity, but reduced soil pH. We assume that biosolids application increased soil C storage through direct supply of organic matter to soil and also indirectly by increasing root biomass. The High biosolids treatment also increased soil concentrations of total Cd, Cr, Cu, and Pb at 25-50 cm, but these values were considered very low for soil. The electrical conductivity and the concentrations of Cu, Cr, and Pb of groundwater appeared to increase over the period of biosolids application. Our results indicate that repeated application of biosolids to a plantation forest on a poor site could significantly improve soil fertility, tree growth, site productivity and C sequestration in the forest and soil, without resulting in any obvious adverse effect on soil and groundwater quality. However, biosolids-derived heavy metals were strongly retained in the litter surface soil. The long-term fate of biosolids-derived heavy metals needs to be monitored further.



Effect of biosolids application on foliar N concentration (top) and tree stem volume (below). Arrows indicate time of biosolids application. Error bars show least significant differences (P = 0.05) for comparisons among the treatments.

UPCOMING EVENTS

The 2014 New Zealand Land Treatment Collective (NZLTC) Annual Conference will be held in Hamilton on the 26th – 28th March 2014 with the theme *'Managing contaminants at a catchment level – back to basics.'*

A CIBR workshop will precede the NZLTC conference at the same venue on the 25th of March 2014.

Register for these events online at http://www.scionresearch.com/general/new-zealand-land-treatment-collective/nzltc-conference-registration

Soil Sampling at the Rabbit Island Biosolids Trial Site *By Alan Leckie*

Soil sampling on Rabbit Island

Alan Leckie and Dave Henley from Scion sampled the soil at the Rabbit Island biosolids trial site in late November 2013. We were very fortunate to have Professor Tiancai Li from the Northwest Institute of Plateau Biology, China with us. Tiancai provided a willing pair of hands and the photographs.

Whilst there, Professor Liming Jia from Beijing Forestry University visited the trial and was very interested to see how a research organisation, a forest company, and local authorities could work together to find sustainable reuse solutions for Nelson's biosolids.

The trial was set up in 1997 and has had six biosolids applications with the latest in November 2012. All 36 plots were sampled at 25 cm increments down to 100 cm to track the fate of the constituents of the biosolids. We are especially interested in where the biosolids-derived nutrients and heavy metals currently sit along the soil profile. In the 2010 soil sample the metals were found at a depth of 50 cm. We are awaiting the most recent results, which we will present in the following newsletter.

Sampling in this way can reveal where substances of interest are found along the soil profile. Note the two distinct colours in this 0-25 cm sample.

Tiancai was happy to lend a hand.

Update from across the Tasman at the ANZBP

By Greg Priest

The Australian and New Zealand Biosolids Partnership (ANZBP) has had a productive first half of the financial year, winding up some research from the previous period and kicking off some new activities. In August the ANZBP was pleased to release two new research products - an update of the Biosolids Production and End Use Statistics publications, first developed in 2010, and an Industrial Contaminants Database, a new database that documents an impressive number of chemicals found in the environment which may be present in biosolids. Whilst the complete research products are only accessible to ANZBP members, a summary of the New Zealand biosolids statistics are provided on the ANZBP website. Many thanks to biosolids managers from councils around the country for their assistance.

Key projects the ANZBP currently has underway include the following three products which will be progressively published in the coming six months:

- Code of Practice – the ANZBP will support the biosolids industry in developing and implementing a Code of Practice for Biosolids Management.
- ANZBP Media Response Kit – a reference tool that ANZBP members can consult to inform the process and possible content of responding to media coverage or enquiries regarding biosolids matters. The tool will also inform users as to 'who' in the industry is best placed to lead any communications.
- Biosolids End-use Strategies Discussion Paper – this will explore and document current biosolids end-use practices/markets in Australia and New Zealand, identify any risks associated with those markets and articulate means to address/minimise those risks and communicate outcomes and strategies to members.

The ANZBP has also been involved in the development and delivery of a number of biosolids events, running a successful workshop down in Tasmania and then participating in another biosolids forum the following day in Melbourne. A presentation by ANZBP Advisory Board member Dr Jacqui Horswell demonstrating CIBR's experiences in community engagement was warmly received by the Melbourne audience and generated much discussion.

The ANZBP Board is keen to come back to NZ to share their experiences as well as learn from yours, however until that happens, keep an eye out for the release of registration for Australian Water Association's (AWA) June 2014 Biosolids Conference early next year.

Wishing you all a happy festive season and great start to the New Year.

The ANZBP is a subscription based program, formed in 2007, to place the beneficial use of biosolids on a sustainable footing across Australia and New Zealand. The ANZBP resides with the Australian Water Association (AWA) which has taken responsibility for implementing the program, and its agreed business plan.

ANZBP Membership enquiries are welcome and can be directed to the Project Manager at admin@biosolids.com.au, additional information regarding the ANZBP can be found on the website www.biosolids.com.au.

Special Interest Article – A sustainable biosolids reuse solution

By Michael Naughton

The Barwon Region Water Corporation is the largest regional water corporation in Victoria, Australia. The corporation provides water and sewerage services for a population of about 295,000 people in the Geelong region, southwest of Melbourne.

During the 1990s, Barwon Water made significant upgrades to its sewage treatment plants to produce high quality, secondary treated water suitable for recycling and discharge to ocean outfalls. As a consequence of the treatment upgrades, Barwon Water began to produce sludge or biosolids - a by-product of the treatment of waste water and sewage.

Initially, biosolids were stored in clay-lined lagoons while Barwon Water sought a process to treat and beneficially use the biosolids.

In 2004, Barwon Water commenced a short-term air drying operation that allowed the corporation to reuse 100% of the biosolids produced from its water reclamation plants and reduce its biosolids stockpile while developing a long-term solution to using biosolids.

The journey to establish a sustainable long-term biosolids solution reached a significant milestone in September, 2013, with the completion of a biosolids thermal drying plant by contractor Plenary Environment.

Plenary Environment is now operating the fully enclosed facility for treating Barwon Water's biosolids. The facility treats the biosolids to T1 Grade, the highest treatment grade under the Victorian EPA Biosolids Guidelines.

The project required Plenary to search internationally for the most reliable and environmentally sustainable technical solution for the treatment of some 60,000 tonnes of dewatered biosolids each year. To ensure the technology was suitable, a pilot plant was imported to test the performance and operation of the drying technology under local conditions.

Biosolids thermal drying facility

Extensive consultation processes resulted in community criteria being included in the contract and delivered by Plenary Environment. The outcome was the selection of a thermal drying facility that:

- is fully-enclosed with zero odour beyond Barwon Water's fence
- is no taller than the existing buildings at the Black Rock water reclamation plant

- produces the highest treatment grade of biosolids possible
- has no visible air emissions
- includes substantial investment in landscaping and aesthetics.

The Plenary solution also involves the beneficial use of treated biosolids. Currently, pelletised biosolids are dispatched from the facility to more than 40 broad acre cropping and pasture farms across central and western Victoria.

Biosolids pellets stored ready for distribution

The facility replaces the practice of transporting biosolids 80 km by truck to the air drying facility and has reduced the number of heavy trucks on local roads by 1,000 movements each year.

The facility places Barwon Water at the forefront of responsible biosolids management in Australia and was one of the first projects in the water sector to be delivered as a Public Private Partnerships project under the Partnerships Victoria framework.

The facility contributes to Barwon Water's long-term goal of a 'no waste' sewerage system – where 100% of recycled water and 100% of biosolids are committed to sustainable use. The Barwon Water Biosolids Management Project provides an environmentally sustainable and long-term management scheme for the biosolids produced by all of the region's water reclamation plants.

Advisory Group Feature – an interview with Michael Naughton

The Advisory Group provides guidance into the long-term direction of the programme. They are a panel of industry, Government, and non-Government representatives with a keen interest and/or expertise in the biowaste field.

Michael Naughton

What is your interest in the CIBR?

My interest in the CIBR is in supporting the sustainable use of biosolids. Through my time in the water industry, I have seen the focus on improved quality of treated water develop into an urgent need to improve the methods used to deal with the solids produced from the improved treatment processes. The community correctly demands we protect human health and preserve our environment by discharging only high quality treated water that does not have an adverse effect on the receiving environment. This concern should also extend to the solids stream. With effective controls over industrial inputs to our sewerage systems through effective trade waste management, high quality sewage treatment processes, the development of recycled water schemes, and processes to treat and safely use biosolids, we have the opportunity to make our sewage treatment systems truly sustainable.

How do you see the information produced being useful to you and to New Zealand and Australia?

The water industries in New Zealand and Australia need to work together to avoid duplicating research and ensure we learn from each other. The community expects we make the most of valuable research dollars. We need to consult with industry and the community as we develop schemes that can deliver benefits to the environment and identify risks that need to be managed. It is essential we learn from each other.

What else would you like to see included in the programme?

I would like to see research outcomes delivered in terms that the community can understand. It is not enough to simply deliver conclusions about research findings that, without explanation, can cause unnecessary alarm in the community. We need to work with the community to understand the real consequences of some of our current waste management methods and identify alternatives that allow us to minimise waste disposal by processing materials into a form where they are able to be used again.

If you had a million research dollars, how would you spend them?

I would spend the million dollars on supporting research into methods of creating a more environmentally responsible culture in our community. This involves understanding how we might better promote each individual's responsibilities to drive improvements to our management of the environment. By highlighting how we, as a community, contribute to the degradation of the environment, we can drive change at a domestic and industry level. The community needs to understand the risks of continuing to deplete our valuable resources without considering all of the relevant long term environmental impacts, as well as other social and economic concerns. We need to move from short term fixes to adopting technologies that complete the nutrient cycle and provide environmentally sustainable solutions to managing materials currently defined as waste products.

Michael is the co-ordinator of recycled water and biosolids operations at Barwon Water in Victoria, Australia. He has more than 20 years' experience in biosolids processing. Michael's experience includes designing and optimising sludge dewatering processes, managing major biosolids transport, storage and air drying operations, and more recently, being the project manager for a contract to deliver and operate Australia's largest biosolids thermal drying facility. Michael is a past chair of the VicWater Biosolids Task Group and is currently chair of the ANZBP Advisory Board.

Update from the Ecotox Team *By Louis Tremblay*

The ecotox team has been mainly focussed on completing outputs from the work conducted during the last few years. Experiments have produced quality data and it is now time to submit the material to peer-reviewed scientific journals. The Waste Minimisation Fund 'Up-the-Pipe' solutions project is now completed. It has generated a lot of interest from various parties. Many radio interviews were given and many newspaper articles were published. The project will be covered in the North & South January issue. The reports from the research are available on the CIBR website.

Grant Northcott, Jo Cavanagh and Louis Tremblay attended the Society of Environmental Toxicology and Chemistry (SETAC)-Australasian Conference in Melbourne from the 1st to the 3rd of October 2013. The three gave oral presentations on various aspects of the work of the CIBR. A talk called 'Securing the Future' on developing a strategy for managing emerging contaminants in NZ was presented at the 'What's in our Water?' symposium. The talk provided an overview of the process to manage emerging contaminants through developing a National Strategy. The initiative is coordinated by Graham Sevicke-Jones from the Greater Wellington Regional Council. The strategy will require a lead government agency that would address the issue by coordinating relevant multi-expertise research capabilities, policy, and key industry participants. The strategy would also ensure that NZ participates in any global research programme aimed at better management of the environmental risks posed by emerging contaminants.

Emerging contaminants are, "any synthetic or naturally occurring chemical or any microorganism that is not commonly monitored in the environment but has the potential to enter the environment and cause known or suspected adverse ecological and (or) human health effects. In some cases, release of emerging chemical or microbial contaminants to the environment has likely occurred for a long time, but may not have been recognized until new detection methods were developed. In other cases, synthesis of new chemicals or changes in use and disposal of existing chemicals can create new sources of emerging contaminants." *(US Geological Survey, 2013).*

Griffith University PhD candidate Phil Scott has nearly completed his research project on the presence and effects of emerging contaminants in Australia, and plans to submit his thesis in early 2014. The project used an integrated approach, combining trace chemical analysis of endocrine disrupting compounds (EDCs) and trace organic contaminants (TrOCs), multiple in vitro and in vivo bioassays, and in situ sampling to compare endocrine activity at 73 river sites across mainland Australia. The study sites were selected to include waterways receiving a variety of point and non-point sources, such as wastewater discharge, agricultural run-off, industrial effluent, urban drains and pristine reference sites. The project is co-funded by industry and the Australian Research Council Linkage scheme. Phil is based at Griffith University and co-supervised by Fred Leusch, Louis Tremblay and industry partners.

Exterior view of the new Cawthron Institute Envirotech Wing

Above: Eisenia andrei worms – a typical test species in ecotoxicology

Exploring collaborative opportunities in China – the role of earthworms

By Jo Cavanagh

Earthworms are commonly used to assess the toxicity of contaminants on soil biota. The species commonly used in laboratory testing are *Eisenia fetida* or the closely related *Eisenia andrei.* These species are used for laboratory testing due to their relatively fast growth and ease of handling. However, the response of *Eisenia fetida* to contaminants may differ from that of common pasture species such as *Lumbricus rubellus,* or *Aporrectodea caliginosa,* thus posing a question about the relative sensitivity of the different species to contaminants. Contaminants such as fertiliser-derived cadmium, or veterinary medicines in dairy shed effluent, influence the distribution of

Cawthron Envirotech wing laboratories

New building at the Cawthron Institute

Cawthron Institute opened their new building named the EnviroTech Wing on the Halifax Street, Nelson site. It includes nearly 400 square metres of high specification laboratory space, along with offices, meeting rooms and staff facilities. It provides scientists with state of-the-art facilities where they can continue their marine and freshwater research. The new building is home to molecular, biosecurity and ecotoxicology experts and includes specialist laboratories, offices, meeting rooms and staff facilities. The building is also the new home of Cawthron's internationally-significant living collection of microalgae cultures. With new equipment replacing out-dated technologies, it will help the institute better meet the needs of its research partners and clients.

earthworms in pastures. Information on the potential effects of contaminants on earthworms would be of value to New Zealand's pastoral sector as another factor to improve pasture productivity. Earthworms can also improve pasture production with some studies observing increases in pasture growth (from 28 to 113%) after earthworm introduction. Earthworms feed on plant litter and dung and move this organic matter into and through the soil, increasing fertility and improving soil structure. New Zealand's pasture earthworms are introduced species and have a patchy distribution; contaminants may play a role in this.

Jo Cavanagh of Landcare Research, along with a colleague from Massey University, will be visiting Shanghai Jiaotong University (SJTU) in China to explore a potential collaborative opportunity with Professors Yinsheng Li and Jiangping Qiu from the School of Agriculture and Biology. The collaboration will investigate the application of molecular techniques to examine genetic changes in earthworm populations in response to contaminant exposure. Ultimately, we aim to compare these genetic responses in typical test species (*Eisenia andrei/fetida*) with those in species typically found in pastures in New Zealand and China. This would extend the utility of information gathered from test species. A specific focus would be the response associated with biowastes such as municipal biosolids and dairy effluent, and fertiliser-derived cadmium, the latter two issues being of interest in dairy farming.

Update from the Social and Cultural Team: Kaikōura District Council Councillors accept CIBR report and community recommendations

By Lisa Langer, Jamie Ataria, Alan Leckie, Joanna Goven and Jinny Baker

Four years of research and community engagement by the CIBR team to investigate biosolids management options with the Kaikōura community is to be implemented by the Kaikōura District Council (KDC). The CIBR team is elated to receive this wonderful news following four hui, interviews with key stakeholders and the broader community, plus biophysical, environmental and economic research to enable the Kaikōura community to determine the reuse solutions for the 1500 tonnes of biosolids that are stockpiled just north of the township.

Following an invitation and with support from the KDC CEO Stuart Grant, Lisa Langer, Jamie Ataria, and Alan Leckie presented the Kaikōura case study community engagement report with recommended biosolids reuse options to the councillors at a KDC meeting in mid-September 2013. They presented a summary of the community engagement process, biophysical research findings, and the community recommendations to the councillors. The community supported three reuse options (in order of preference):

1. Application to exotic forest plantations
2. Application to rehabilitate land with native plants
3. Composting biosolids (both open air composting and vermicomposting) prior to being sold.

The councillors in turn asked a number of science questions before unanimously accepting the CIBR report and recommendations.

Extract from KDC minutes 18 September 2013:

"Moved by Mayor Gray, seconded by Councillor Diver and resolved that Council receive the report entitled Kaikōura case study: community engagement to determine biosolids reuse and adopt the recommendations contained in the report which were:

- *Kaikoura District Council gives transparent consideration of the options preferred by the community for future reuse of the stockpiled biosolids, relative to the constraints of the Council plan and budget.*
- *The Centre for Integrated Biowaste Research (CIBR) team [continue to] work with Council and community to help facilitate the next steps in the process.*
- *The CIBR develop a best practice or 'fit for purpose' framework using the Kaikoura collaborative process to guide other Councils and communities to consider options and adopt sustainable reuse solutions for biosolids reuse. The CIBR encourage other local governments and communities to adopt similar forms of collaborative community engagement to generate robust and sustainable decision making for other environmental health issues."*

This paves the way for the council to implement the research findings following the community's recommendations to apply the stockpiled biosolids to the Clarence forest and rehabilitate land with native plantings. Importantly for the research team, it shows uptake of four years of integrated CIBR biophysical, social, economic and cultural research within a rural district of New Zealand. The next steps for the social and cultural team in Kaikōura include feeding back this outcome to the community. A press release with KDC to the Marlborough Express is planned along with a community presentation – possibly to the community environmental action group, Te Korowai o Te Tai o Marokura. The team will continue to support the KDC to implement preferred options.

The CIBR team would like to thank all those who contributed over the years to reach this point of implementation, including the staff of KDC, Te Rūnanga o Kaikōura, and the Kaikōura community.

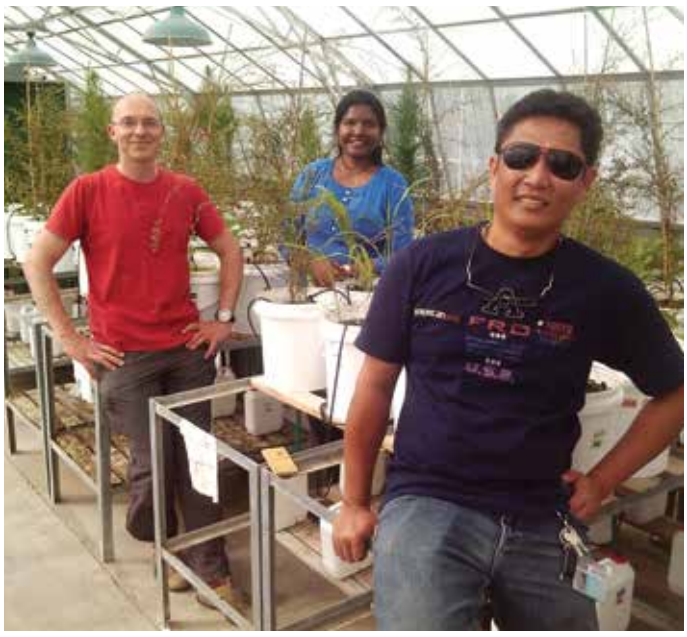
Special Interest Article – the phytomanagement of biowastes

By Brett Robinson

Phytomanagement describes the use of plants to improve environmental outcomes while producing valuable biomass. Obed Lense is starting his PhD on the phytomanagement of biowastes under the supervision of Jürgen Esperschütz, Nick Dickinson, Jacqui Horswell and Brett Robinson. Potentially, mānuka (*Leptospermum scoparium*) could be grown on biosolids-amended soils to produce valuable honey. Other economically important plants in the trial are kānuka (*Kunzea ericoides*) for the production of firewood and essential oils, and pine (*Pinus radiata*) for timber production. Sorghum (*Sorghum bicolor*) and oilseed rape (*Brassica napus*) may find a role in bioenergy production on biosolids-amended soils. A feature common to these species is that they are all Biological Nitrification Inhibitors (BNI), which means that they inhibit the transformation of the ammonium, an immobile plant nutrient, into nitrate which can leach into groundwater.

While overseas studies have shown that pine, sorghum, and brassica may be BNI, pioneering work by Lincoln University Honours student Rachel Downward has shown that some New Zealand native species also have this property. Planting BNI in biosolids-amended soils may thus reduce nitrate leaching, which is the factor that limits the application of biosolids to land in many jurisdictions.

While BNI may reduce nitrate leaching from biosolids over the long-term, the initial load of nitrate present in biosolids may cause a large pulse of this contaminant to leach shortly after application. Dharini Paramashivam has found that mixing biosolids with wood-waste and charcoal (i.e. other biowaste streams) can mitigate this nitrate leaching and further promote plant growth. The phytomanagement of biowastes is most appropriate on degraded soils, where contaminants that are often associated with biowastes, such as heavy metals, are less important. This technology could be used in New Zealand and worldwide to rebuild degraded soils, provide a beneficial use for the biosolids and produce an economic return off the land.



Mini-lysimeters at Lincoln University with mānuka, kānuka, pine, sorghum, oilseed rape and pasture. From left to right: Jürgen Esperschütz, Dharini Paramashivam and Obed Lense

'Towards Sustainable Biowaste' – a community hui at Mokai Marae

By Jacqui Horswell and Jinny Baker

A final hui was held on the 14th of August 2013 at Mokai Marae near Taupō to bring together about 40 key stakeholders and members of the wider community. These included staff and students from Tirohanga School, and representatives from local and central government. The hui provided an opportunity for researchers from the CIBR programme to share information from the work at Mokai and in the Taupō region, as well as highlights from the wider biowaste programme.

In contrast to Kaikōura, most homes in Mokai use septic tank systems. Currently the waste is trucked to and treated at the Taupō waste water treatment plant. The CIBR team have been working with the local community exploring on-site waste management systems that reflect their cultural, environmental, social and economic values.

Together with the community, we identified an interest in vermicomposting as a treatment process that may reduce social and cultural concerns surrounding land application of biosolids. For example, some people felt that passage of septic tank waste through a worm would transform it from 'human waste' into high quality 'compost'. Scientists from the CIBR presented their findings on the viability and scalability of vermicomposting mixed wastes such as septic tank, green and dairy wastes from Mokai. Hui attendees heard that vermicomposting is good for recycling biowastes into a valuable organic fertiliser, but that extra steps in the composting process may be required to produce a pathogen free product.

As all the homes in the Mokai community are connected to septic tanks, a key focus of the hui was to provide the community with information on ways of improving efficiency of the onsite systems, many of which are old and failing. With the help of the students from Tirohanga school, hui participants also heard how to look after the recently installed septic tank system at the Mokai Marae. The students produced posters for the wharekai (dining room) and wharepaku (ablutions block) at the marae with tips on what you can and can't put into the system.

The hui was designed to be interactive and provided the opportunity for participants to take part in making their own cleaning and personal care products. All participants could make and take home a lemon hand scrub, toothpaste, and a foot powder. They also got to try a traditional natural mouth wash made with rongoā, traditional Māori healing herbs such as kawakawa (*Macropiper excelsum*).

The hui was very successful in bringing members of the community together to discuss and debate their views on developing a community waste management strategy with a focus on improving the health and function of the septic tanks in the Mokai community.

On behalf of all the staff in the CIBR we would like to thank our research partners from Mokai for their superb hosting and for their support, engagement and invaluable contribution to the research programme.

We would also like to thank Donna Andrews, the Principal at Tirohanga School, the students and parents of Tirohanga School, the Mokai marae and Mokai community members, especially Ngaire and Eru George for their assistance.

Posters displayed in the marae to provide information for the community and visitors on caring for the septic tank system and the environment

A Tirohanga school student tries a traditional natural mouthwash

Students got to make their own environmentally-friendly personal care products like foot powder

‘Up-the-Pipe’ Solutions Education Intervention: Tirohanga School, Mokai *By Jinny Baker, Jacqui Horswell, James Ataria and Lisa Langer*

The Ministry for the Environment-funded ‘Up-the-Pipe’ solutions promotes awareness in communities about what is disposed of down the drain. We want to gain a better understanding of the implications of our actions for human and environmental health, and how these risks and uncertainties can be best managed today and in the future. The ‘Up-the-Pipe’ solutions project focuses on school education to see how students and their whānau can change their household waste practices. It also equips students as the decision makers of tomorrow to plan how they might deal with growing global issues and ‘wicked problems’ like waste.

For this education intervention, the CIBR team designed learning resources to raise awareness and support behavioural change by encouraging students to be ‘change instigators’ within their whānau. Our resources encouraged students to engage with their families to explore household awareness of waste, waste management and environmental care activities, and reasons for purchasing personal care and cleaning products. Our approach provides a supportive learning journey for students and involves the marae, local government, community business leaders, and students’ families (as current household decision-makers). The approach also empowers students themselves as tomorrow’s generation of household consumers, decision-makers, leaders and innovators. We created a series of resources and exercises that would support teachers in explaining the bigger picture about what goes down the drain, provide hands-on experiential learning about alternatives, and equip students with thinking tools for behaviour change.

The ‘Up-the-Pipe’ solutions team worked with Donna Andrews, the Principal of Tirohanga School in Mokai to develop curriculum activities suitable for a younger age group. Viki Ambrose (a trained school teacher with a Master’s degree in science) worked with Donna to develop the classroom activities into curriculum units for other teachers to access. A key focus on this work was to create ‘Up-the-Pipe’ solutions messages that were relevant for the age group and to ensure a strong relationship with local issues and concerns.

Students adding greywater to their plants

Presentations by Tirohanga School students

Tirohanga School in Mokai

Tirohanga School is a rural school in an area with a large Māori population. The curriculum work was oriented to explore the underpinning value of water as taonga, a precious resource vulnerable to pollution from household and farming waste. Some of the activities supported by the school included modules on understanding how a septic tank works and exploring the function of wetlands as ecosystems, and a visit to a local farm to look at effluent treatment.

A greywater reuse experiment was also conducted by the students with the help of Morkel Zaayman, a Masters student in the CIBR programme at ESR. Greywater consists of the water from showers, baths, bathrooms sinks and laundry and can account for up to 75% of the wastewater from a domestic household. In New Zealand many households practise greywater diversion to relieve the pressure on their septic tank system. As all the homes in the Mokai community are connected to septic tanks, there is a real interest in the community in improving efficiency of the onsite systems, many of which are old and failing. Greywater contains an extremely variable and complex mixture of nutrients that can be good for plant growth as well as microbes and chemicals that can potentially have detrimental impacts on the environment and public health. The students were challenged to carry out an experiment to answer the following questions:

- Can we add too many nutrients to the soil?
- What happens to plant growth when we add greywater?
- Is greywater good for your garden?

The students were divided into groups where they took ownership of a treatment for the experiment. There were two treatments and a control; bad quality greywater, good quality greywater, and tap water. The bad quality greywater represented the accumulation of sodium in soil over a 10 year period from daily irrigation. Each treatment had 3 replicates and involved the irrigation of a set volume of greywater onto the plants every day, except weekends and school holidays. The experiment ran for 7 weeks to the 13th August, one day before the hui.

Results boards from the greywater experiment

The students monitored their kōhūhū plants (*Pittosporum tenuifolium spp. Colensoi,* supplied by Mark Ross of Whenua.biz) throughout the experiment for any changes in appearance, taking note of leaf colour, leaf number, stem height and appearance. Plants were harvested at the end of the experiment and roots washed to remove soil/potting mix. The root-mass of each replicate was calculated by weighing at the conclusion of the experiment.

At the Biowastes hui on the 14th of August 2013, the students presented poster boards that showed their results and discussed their findings. The students concluded that there was no difference between plant height, number of leaves, and root mass between the 'good' and 'bad' greywater. They learnt that greywater can contain plant nutrients that can help plant growth. The scientists and the students also wondered why the plants had not died in the 'bad' quality treatments – at the hui Mark Ross informed the group that kōhūhū are very tolerant plants and this was likely why they grew well – everybody learnt something from the experiment!

Feedback from the school indicates that the students thoroughly enjoyed their day at the Mokai hui, and the experience of being a part of a bigger picture in a field of scientific experts. They gained the impression that doing science was fun and exciting, and that science is something that can change how we look at things. For the greywater experiment the students especially enjoyed tending to the plants and learning that greywater can be used on plants. They learned how to collect and record data, make comparisons, and design ways to present the information to others.

The students have since extended the 'Make Your Own Product' activities they did at the Mokai marae hui, and are now doing a project called 'Holiday Get Away'. This involves the students 'pricing' and identifying the costs involved in doing something they all want to do, and then calculating how much money they will need to make to cover these costs. They are going to see how they can improve some of their environmentally-friendly handmade personal care products (e.g. mouthwash and toothpaste), then look at how to package and market their product. This will include choosing the right price and marketplace to sell it. Under the guidance of the school principal, this extension work demonstrates how science learning can support innovation and entrepreneurship.

Centre for Integrated Biowaste Research

CIBR workshop: Advancing resource recovery and reuse of biowaste

25th March 2014, Novotel, Hamilton

CIBR is a multidisciplinary collaboration between 10 New Zealand research institutes, universities, and research partners dedicated to developing appropriate and sustainable solutions that maximise the benefits and minimise the risks of using biowaste. Biowaste includes the biodegradable parts of municipal waste, such as food and garden waste, paper, cardboard, some textiles and wood. It also includes livestock manures and slurry, treated sewage sludge, organic industrial waste (such as paper and textiles) and compost. Underpinned by Government Core Funding, this virtual research centre aims to address critical gaps in New Zealand strategies related to biowaste, in recognition of the 'national good' of research.

The workshop will precede the New Zealand Land Treatment Collective Annual Conference and review recent advances in biowaste research including:

- Beneficial reuse options;
- Costs and benefits of management options;
- Environmental impacts e.g. LCA;
- Industrial organic waste management;
- Wastewater and biosolids;
- Greywater;
- Emerging pollutants;
- Legislation and guidelines; and
- Behavioural issues.

Who should attend?

Utility operators, regulators, contractors and researchers who deal with biowaste are encouraged to attend this workshop.

Additional Information & Registration: Morning tea, a light lunch and afternoon tea will be served.
Registration fee is $50 (incl. GST) payable with your NZLTC conference registration.
You can register online at http://www.scionresearch.com/general/new-zealand-land-treatment-collective/nzltc-conference-registration

For further information: Contact the Programme Manager Dr Jacqui Horswell Email: Jacqui.Horswell@esr.cri.nz

March 2012 Kaikōura hui – evaluation by scientists

By Alan Leckie, Lisa Langer and James Ataria

Photo courtesy The Marlborough Express

Following the successful community hui at Takahanga marae in March 2012 to determine biosolids reuse options for the stockpiled Kaikōura biosolids, Alan Leckie conducted telephone and face-to-face interviews with eight scientists from the CIBR team who had participated in the Kaikōura community engagement case study and hui.

As with the feedback from community participants at the hui (reported in the Biowaste Project Newsletter No. 5, Summer 2012), the feedback from CIBR scientists was overwhelmingly positive.

Presenting ourselves to the community – *He kanohi kitea* ("The seen face")

Scientists who were interviewed felt that meetings between researchers and the community should be face-to-face to enable the community to interact and build relationships with the researchers.

"We have been up in the community for a while . . . we are a research team that has been seen. Some members of the team are legendary up in Kaikōura and have become the face of the research team. This demonstrates the importance of going back into these communities."

Collaborative strength of engagement with the community – *Nāu te rourou, nāku te rourou* ("With your basket and my basket")

The Social and Cultural team ran five hui, held monthly phone meetings, and retreats to ensure their energy was translated into the research findings.

"The power . . . to really involve communities in sustainable futures and decision making is quite rewarding."

"The multidisciplinary approach that gives us the scope is the key strength of it."

"The social scientists [are] a very good way to pass on knowledge and any research findings into the communities."

Five minute science presentations – *Ahakoa he iti, he pounamu* ("Even though it is small, it is precious")

Each scientist gave a five minute presentation outlining their research results to provide the key information in a simple and easily understood way. This enabled the community to make recommendations on the biosolids reuse options.

". . . a lot of the scientists did embrace the five minutes and take a punt on it . . . and trusted [the social scientists] to do the right thing by the programme and them."

". . . to distil it down to just one or two literally key messages was the right way to proceed."

"The process was very nice in terms of building consensus in a common pathway."

Hui process

Using the hui process for community participation enabled a positive interaction between the scientists and the community. Everyone understood everything.

"We were able to get the community to participate; it's actually a good approach . . . we could certainly replicate [this] in our other community engagement."

"I think we were able to deliver what we had done in a way that people could grab and use to make a decision."

"I think it's very successful. I mean, we have involvement from so many . . . scientists, council, community and Māori."

"Each person had an opportunity to talk within the group setting and could talk individually – it was a good idea."

The ability of the CIBR team to engage with communities is a real strength; it enables collaborative solutions to community problems. However, underlying this is a research team culture and individuals that have grown since the beginning of this programme to embrace a more shared approach to the science.

He aha te mea nui o tēnei ao? *Māku e kī atu, 'He tangata, he tangata, he tangata.'*

What is the most important thing in this world? I say, 'It is people, it is people, it is people.'

If you would like further information on the programme or have any questions, please see our website www.cibr.esr.cri.nz or contact a member of the Science Leadership Team:

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