

June 2022

# ORGANICS WASTE TO VALUE FORUM

## WHAT WE HEARD

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# Introduction

## Background

Organic waste accounts for approximately 30% or more of disposed waste in NL. Both research and practice have shown there are practical strategies for the use of organic by-products (or “residuals”) from forestry, agriculture, fisheries, and aquaculture sectors as inputs for the development of other types of beneficial products. Similarly, there are examples of effective community and regional scale efforts to convert residential-municipal organic waste into compost and other products with beneficial uses.

Through the work it was doing as part of its long-standing partnership with the Multi-Materials Stewardship Board, the Harris Centre increasingly heard a growing interest among multiple groups in pursuing these opportunities. The Harris Centre worked closely with a planning team (Appendix B) to design and develop this cross-sectoral dialogue seeking to:

- Clarify and better understand the current interest and opportunities for developing practical “waste-to-value” enterprises in NL – both within and across organic waste streams and sectors.
- Explore which strategies and enterprises are the most relevant, viable and offer the greatest potential impact – both waste diversion and socio-economic value-added – for NL.
- Begin to identify a few “actionable opportunities” – current feasible opportunities for combining and using organic waste materials from sources primarily associated with the forestry, fisheries, aquaculture and agriculture/food sectors – participants believe they can develop immediately.
- Inform and advance policy discussions within NL that support the development of these opportunities and, more broadly, enable the adoption of waste-to-value approaches for organic waste streams.

## Forum Overview

On April 22, 2022, the Harris Centre hosted the Organics Waste-to-Value Forum. Over 50 participants (Appendix A) from forestry, agriculture, fisheries, aquaculture, waste management, local and provincial government, academia, research institutions and others came together to identify and explore potential organic “waste-to-value” opportunities (i.e., using these materials as feedstocks for creating new products, enterprises and other social and economic benefits) in Newfoundland and Labrador.

Through a mix of presentations, information sharing and group discussions (Appendix C), Forum participants were invited to identify the next steps towards realizing what they saw as

- The most promising of these waste-to-value opportunities;
- Significant challenges or barriers that would need to be addressed; and
- Potential next steps to advance the discussion and work.

In order to promote openness in this discussion, participants were invited to express their individual experiences with and opinions on the utilization of organic waste materials. This “What We Heard” document purposely presents participants’ comments anonymously and with minimal editing for purposes of clarity.

# What We Heard – Part 1

## Morning Discussion Sessions

After sharing their ideas for the wide range of potential waste-to-value approaches and opportunities across the four sectors (Working Session #1), Forum participants were asked to select the 2-3 ideas from their small group discussion they felt would be more feasible and have a greater economic benefits and waste diversion impacts (Working Session #2).

Through these small group discussions, participants identified the following list of opportunities for advancing waste-to-value strategies:

- Pursue pilot project that would allow us to go through the process → help us figure out the barriers – including policy barriers – by doing it.
- Develop and establish standards for organic waste management facilities → create clear guidelines and expectations for organizations and companies so they know what they need to do.
- Identify the needs and opportunities to change rules & regulations to become more supportive of waste-to-value and associated economic development; create a stronger policy environment for supporting business development.
- Look specifically at opportunities for using lower value residuals/materials; turn low value to higher value through collaboration with academia/researchers.
- Stronger collaboration between research community & industry.
- There are opportunities in aquaculture for extracting and using higher quality organic materials and also for biosolids management.
- Household level collection and separation of organic waste → increase opportunities and feasibility for combining residential and industrial organics.
- Develop options for more effective separation of materials/organics at or near the source.
- Identify and adopt industry “best practices” at the source.
- Explore and develop regional approach(es) in order create economies of scale.
- Integrating waste management into regional and economic development.
- Take advantage of the infrastructure that already exists here (e.g., regional waste facilities) → locations could serve as an “incubation space” for new approaches and enterprises.
- Regionalized policy framework.
- Explore specific opportunities for public-private partnerships → what are the specific opportunities with different levels of government.
- Creating opportunities and support for entrepreneurship and “middlemen” to manage waste for different sectors (not job of farmer or sawmill owner); how do we support entrepreneurship in this area.
- We need better measurement & data on organic waste streams (volumes, qualities, locations, etc.) in order to understand specific opportunities; quantification and qualification of our waste.
- Develop the technology needed for tracking organic waste streams.
- Broaden awareness of local initiatives, assets, and collaborations → there are things already happening that we can grow, replicate or learn from.

- Human behavior and culture affect practices and policy → need to develop a better understanding of why we do what we do here in NL.
- More opportunities and supports for bringing people and sectors together → put the pieces together and create pilot projects/programs that enable collaboration between industries.
- Need to think about logistics (transportation, consistency of supplies, etc.) → regulatory authorities' role to create a framework that companies can then work within?
- Ban on organics to landfill, with a specific implementation timeline.

## What We Heard – Part 2

### Afternoon Discussion Sessions

Working with the list of ideas emerging from the morning discussion sessions, members of the project and planning team created six themes that served as the framework for the afternoon's discussions. Participants were invited to select one theme and join with other participants in further discussing the ideas, needs and opportunities in this topic area. Within each theme, participants were asked where possible to highlight one or more opportunities that fit into these three categories:

- **“Tangible” opportunities** (i.e., ready to go → we can pursue this immediately; short to medium-term deliverables/impacts);
- **“Possible” opportunities** (i.e., good plausible idea that could happen in the medium term, but we need to bring additional folks together to sort through how to make it happen); and/or
- **“Longer-term potential” opportunities** (i.e., this could have a big impact/return, but there are quite a few questions that need answering; suggests some needed applied research).

### Themes & Responses

#### **A. Creating multi-sectoral collaboration spaces**

- Important to regionalize as regions will have different ways of handling multi-sectoral collaboration spaces
- Data acquisition: Data is needed on location, volume, type, composition, characteristics of waste stream in order to see the full picture of where we are and where we want to go from here
  - ↳ Essential – create a working group with people from different sectors (forestry, agriculture, aquaculture, etc.)
- Questions:
  - Should the data be scaled or drone data (surveys for volume) vs larger assumptions

#### **B. Regional approaches**

- A regional framework for waste management already exists on the island portion of the province, including governance and administration of those regions. Much of the

infrastructure and capacity is already well established; e.g., there is already transportation and collection network (though focused on residential waste rather than Industrial-Commercial-Institutional sectors), waste site, facilities, all in place.

- Gaps:
  - Infrastructure specifically for organics, needs to be created.
  - There isn't much knowledge of quantification of organic waste, we don't know the characteristics and makeup of this organic waste.
  - Bit of knowledge gap of organics processing
- Benefits of regionalization to deal with these gaps:
  - Already some resources amongst various bodies and organizations, connections with various groups, governments, sectors within their regions
  - What region-specific needs are there? Scale appropriately for your own region
  - Can create an environment for material exchange and innovation within the region
- Government being the leader may not be the best solution; industry can drive this and region can help support as it goes through.
- Barrier for regional approach – the province has regions for waste management, but not all regions are at the same level of operations, not all are as established yet.

### C. Data quantification

- Absence of data at local/regional and provincial levels is a significant barrier to progress
  - ↳ **Tangible opportunity:** Inventory database so we can know the gaps, barrier is that units are not mandated to report on waste that is being disposed, can ask industries (some may be doing it anyway), so engage with industries to understand the practices they already follow; process the data to make it useable
- Waste collection being supported and traced by the industry → need to show the benefit of sharing the data, value from waste, using data and collaboration to the benefit of everybody
- Questions/Opportunities:
  - Industry can share data, better collaboration = better data; what sort of barriers are there with industry partners, what IP barriers are there when different companies own data collection systems?
    - One way to do that is living labs framework (adopted by Eastern Health) – a great place to start.
  - Data is relevant to what is collected in information, disagreeing on where waste was actually going, could you see an immediate implementation that someone has to record on where waste is going?
  - Pilot projects, start small and scaling up, learning what challenges are there along the way take it from there (e.g., are there confidentiality issues, IP issues, etc.) share with others.

**D. Public policy/standards and regulations supporting business development**

*[Note: whereas most of the small discussion groups were able to develop some level of shared observations and suggestions, this group explicitly noted that their report back to the full group was not a consensus set of comments. Instead, each of the following comments may represent the views of just one or a few of the members in the group.]*

- Stopping the one-offs to go against the existing policies (amendments happen all the time, fish going into landfills etc.) → stopping the exception to the rules.
  - Needs to be existing facilities in place to stop this so that material has somewhere else to go
- Specific policy levers outside of waste management regulatory framework:
  - Generate electricity and sell it to the grid, micro grids
  - Address high transportation costs in NL (change to transportation policy)
  - Modify farm protection act → currently farmer is protected to compost, but somebody wanting to process this downstream is not protected from community complaints (can modify act to broaden this further)
- Update municipal regulations with updated definitions (many communities use old definitions of terms like agriculture for example)
  - Clear guidelines that counselors who are not experts can look to and understand
- Need for multi-sectoral advisory board, need for different government departments and agencies to talk to each other, the onus is falling on entrepreneurs to encourage connection
- Walk ideas right through, address challenges and policy barriers as you go, so people who want change don't have to do it on their own
- Start with small policy shifts; go out and look at other provinces for what they do for organics, going incrementally is the way to go and making specific changes can be very effective
- Ban on organics in landfills; some business and organizations rely on organic waste going to the landfill in order to continue to be financially sustainable, so we need to define timeline and start picking up waste that we will not allow in landfills anymore
- Not a lot of players in this market, only about 15 in the province looking to expand; we need to solve this for those who wish to go forward and move ahead – not policies that need to apply to everything under the sun, policies can be more specific to allow things to move forward.

**E. Ecosystem infrastructure (brokers and entrepreneurship)**

- Look for natural and economic clusters – We are a very diffused province in terms of industry and population; certain areas are more equipped to deal with certain waste streams in terms of raw materials
  - Need for regional examination; we are still grasping at straws for getting accurate numbers for these things

- **Tangible opportunity:** start with a holistic approach to create a baseline study of waste management among provincial regions → what do our organic waste streams actually look like?
  - Need this so that we can create business models relevant to each region
  - Government, industry and municipal partners can work on this now.
  - Foundational knowledge can attract investment into pilot projects, fosters industry, gov, academic engagement etc. Solid foundations and numbers to back it up and help move it along, leveraging government and investor support
- **Long term opportunity:** regional approach to handling different types of organic waste, can we scale this so it works in other regions, more holistic and integrated approach to waste management in NL
- Question: Is there political will to limit offshore trawlers unfettered ability to dump their waste in seas? Would an investigation include information about fish processed on boat that doesn't make it to shore?

#### F. Research collaborations

- Some of the challenges include:
  - Effectively communicating complex ideas to industry and general public
  - Having restrictive funding to the lab and research (nothing beyond pilot project)
    - ↳ Develop policy changes and collaborate with funding partners to do things beyond the pilot scale, host more conferences, let people know there's research out there (MUN, CNA)
  - Pilot projects can be an effective way to start, but often are not able to continue past the pilot stage
  - Building trust with industry; industries may not see the benefit of taking risks associated with new or different approaches
  - Public reluctance to change and accepting new technology as they believe it may upend their communities, jobs etc.
- How collaboration with industry works depends on who the partners are; many different types of resources → how do we find the best match for desired outcomes?
  - In terms of capacity, Environmental Policy Innovation Lab at Grenfell can help develop student capacity, designed to address questions relative to the province
- **Tangible opportunity:** expand Memorial's focus beyond the Avalon → have educational sessions, tell people what research is going on, and engage with industry and general public in regions across the province.

## Closing Reflections

To close out the Forum's discussions, we invited leaders from each of the key sectors to share their thoughts and reflections on the day's discussions, including:

- Anything new or interesting that caught their attention;
- Any specific ideas or strategies they felt had promise and could be pursued further; and
- Initial thoughts about next steps.

### What We Heard

#### ***Incomplete and insufficient data needs to be addressed.***

- Surprising the degree to which we don't know some of the waste streams or how much of the material might be available – action required here
- Forestry has very well measured and quantified waste streams (and are pretty consistent)
- Importance of data (except forestry), discrepancy with what exists – priority going forward

#### ***Create better opportunities and support for innovation and entrepreneurs.***

- Gap in entrepreneurs and manufacturing – let's bridge this gap
- Who are the innovators, companies, and middlemen etc. who can close these gaps? Better define problems and opportunities to attract these people into these spaces

#### ***Opportunities and interest in collaboration exists – create mechanisms for further developing the discussion and potential collaboration needed in this area.***

- We need to work together, larger scale working group of policy makers and industry to make solutions ahead of time
- Issues in every sector and people want to work together to find solutions and utilize waste to the best of our ability
- Mechanism for continuing after bringing vast amount of expertise into the same room
- Establish an advisory council going forward; take advantage of today's discussion.

#### ***Agriculture sector is diverse – has both big opportunities and complexities.***

- Opportunities for fertilizers, create soil, products to enhance food production in the province.
- Agriculture cannot be viewed as a dumping ground, each organic product is different, mindful of what is contained in different organic materials before we put it in the ground, fertilizers need to be certified and have proper labelling.
- Provincial soil laboratory used by farmers, can test any product with nutrient claim, help develop recipes for compost, expertise on staff to do that work for free.
- Organic waste from slaughterhouse, (in pet food, feather meal) not currently being captured.

***Look at appropriate scale and models for maximizing capturing the economic value and community benefits from organic waste.***

- Going forward – consider a regional basis (business models, return on investments).
- Economics of scale – have to make sure we are creating products in a form that can be used, applicability of products we are creating.
- The importance of maximizing the resources we're taking out now and increase economic and community value of what we take out.
- Every waste has value and it is important to capture this.

## Next Steps

One intention of the **Organics Waste-to-Value Forum** was to share information, create connections and encourage participants to discover new opportunities of mutual interest. As a reflection of the Forum, we hope this report will also serve that purpose. We encourage all Forum participants and other interested readers of this report to use the Forum and the information in this report as a catalyst for pursuing ideas and actions – both on their own and in collaboration with others – within their realms of interest.

As the convener of the Forum, the Harris Centre has identified two themes it feels it is in a position to advance given its capacities and mission. Working in collaboration with other partners, the Harris Centre intends to explore opportunities to support and advance efforts in the following areas:

1. Incomplete and insufficient data on organic waste needs to be addressed.
2. Opportunities and interest in collaboration exists – create mechanisms for further developing the discussion and potential collaboration.

The Harris Centre will also continue to maintain the website created for the Waste-to-Value Forum;

<https://www.harriscentreforum.ca/organics-waste-to-value-forum-2022>

We will use this site to post new information and initiatives relevant to advancing organics waste-to-value efforts in Newfoundland and Labrador as we become aware of it. Likewise, we invite others to use this site to share ideas and resources.

Thank you.

## Appendix A – Participants

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Ever Green Environmental Corp.

Rajib Biswal  
Grenfell Campus, Memorial University

Emily Bland  
SucSeed

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Marine Institute, Memorial University

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Central Newfoundland Waste  
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Nicholas Fairbridge  
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Keith Hutchings  
Canadian Centre for Fisheries Innovation

Jonathan Kawaja  
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Agriculture

Amana Kedir  
Memorial University

Hillary King  
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Andrew King  
City of Corner Brook

Jason King  
Western Regional Service Board

Mark Lane  
Northpine Foundation

Roseanne Leonard  
NL Association of CBDCs

Michael Long  
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Laura McCardle  
Johnson Geo Centre

Sharon McLennon  
NL Workforce Innovation Centre

Sean McNeill  
Canadian Centre for Fisheries Innovation

Paula Mendonça  
Technology Transfer and Commercialization  
Office, Memorial University

Steve Moores

PARDY'S Waste Management and Industrial  
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Susan Moulard  
Government of NL, Department of  
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Harold Murphy  
Burin Peninsula Regional Services Board

Andrew Niblock  
City of St. John's

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Robin Philpott  
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Angela Viviana Ramirez-Luna  
Planeet Consulting

Aaron Ryan  
College of the North Atlantic

Gary Ryan  
Multi-Materials Stewardship Board

Ana Larissa Santiago Hansted  
Memorial University

Glenn Sharp  
Sharp Management

Wayne Simmons  
NL Federation of Agriculture

Kevin Smith  
Grieg Seafood Newfoundland

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Jeremiah Vallotton  
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Jamie Ward  
Harris Centre Regional Analytics Lab

Ben Wiper  
3F Waste Recovery

Jonathan Yick  
Independent

Zhiwen Zhu  
Memorial University

## Appendix B – Forum Planning Team Members

Kieran Hanley, [econext](#)

Bill Dawson, [NL Forest Industry Association](#)

Darrell Green, [Newfoundland Aquaculture Industry Association](#)

Derek Butler, [Association of Seafood Producers](#)

Kalysha Snow, [Newfoundland and Labrador Federation of Agriculture](#)

Joshua Smee, [Food First NL](#)

Ashley Burke and Gary Ryan, [NL Multi-Materials Stewardship Board](#)

Keith Hutchings, [Canadian Centre for Fisheries Innovation](#)

Chris Paterson & Bojan Fürst, The Harris Centre, Memorial University

## Appendix C – Forum Agenda & Discussion Questions

- 8:30am Welcome & Overview
- 8:50 Opening Panel: Perspectives and Perceived Opportunities
- Robin Philpot (Forestry)
  - Wayne Simmons (Agriculture)
  - Keith Hutchings (Fisheries)
  - Kieran Hanley (econext)
- 9:20 Working Session #1: Ideas & Opportunities (*smaller group discussions*)
- 10:00 Break
- 10:15 “Reality Check” – Different Ways of Thinking about Possible Opportunities
- Kelly Hawboldt, Engineering & Applied Science, Memorial University
  - Joe Pittman, Burin Regional Service Board
  - Ed Evans, Central Regional Service Board
  - Andrew Niblock, City of St. John’s
- 11:00 Working Session #2: Focusing Our Attention (*smaller group discussions*)
- 11:30 Report Back & Discussion
- 12-1pm Lunch
- Peter Haring, Department of Environment and Climate Change
- 1pm Memorial and CNA as Resources and Potential Partners
- Michael Long, Applied Research and Innovation, College of the North Atlantic
  - Paula Mendonça, Technology Transfer and Commercialization Office, Memorial University
  - Jamie Ward, Harris Centre Regional Analytics Laboratory, Memorial University
- 1:40 Working session #3: Moving from Ideas to Action (*smaller group discussions*)
- 2:30 Break
- 2:45 Report Back and Discussion – *Building an Emerging “Opportunity Agenda”*

3:30 Closing – “Roundtable Reflection” & Next Steps

4:00pm Adjourn

### Discussion Questions:

1. Working Session #1: Ideas & Opportunities
  - *What’s already happening and working here in NL?*
  - *What opportunities are we missing?*
    - *Are there interesting approaches or examples from other places that could work here in NL?*
    - *Could we expand some of the things “already working” here in NL?*
    - *What could and should we be exploring further?*
2. Working Session #2: Focusing Our Attention
  - *What do you see as most promising and feasible/actionable opportunities or areas for further exploration and development?*
3. Working session #3: Moving from Ideas to Action
  - *Based on this morning’s discussion and what we heard/saw from the research community, what are or could be 2-3 priority “actionable opportunities” to pursue?*
    - *Are there natural geographic and economic clustering across sectors and waste streams to be considered and taken advantage of in NL?*
  - *What can we (the groups/sectors in this room) do to begin to develop these opportunities?*
  - *What is standing in our way? (What are the key barriers, gaps and questions that need to be addressed in order for this to be successful?)*

# Appendix D – Handout 1: Forum Participant Objectives

Containing Participant Responses to Pre-Forum Question,  
“What are some things you would most like to “walk away with” from this Forum”?

## WE ASKED...

*What are some things you would most like to “walk away with” from this Forum?*



- Potential opportunities and different possible ways to deal with organics waste.
- Ideas to be more sustainable.
- Learn new waste innovations.
- Industry driven approaches to divert organic waste.
- Listening and learning about what organic waste exists in the province. Hearing from other industries what their issues are.
- Learning more about innovative ideas/projects around organics management.
- Hearing industry's perspective around the challenges they face.
- Better understanding and appreciation for some of the challenges
- Share ideas; come up with a few actionable items
- The biggest opportunities in NL to use organic waste.
- An idea of what various industries and partners are doing to move the waste to value movement forward in the province.
- More knowledge on the wastes in NL and how we can get value from these wastes.
- Learn about waste streams in other industries for commercialization.
- Input and ideas from participants regarding organic waste diversion as a regional and provincial priority; and information on prospective sources of organic and fibre waste.
- Size the waste volume opportunity for each sector.
- Techniques/resources/policies that can be developed to support waste treatment and utilization.
- Extent to which current regulatory environment compels industry to deal with organic waste stream.

## ...YOU ANSWERED

- Information about waste streams, volumes and utilization potential.
- Better understanding of the types and amounts of material that is generated, and the drivers to divert this material from the generator's standpoint.
- The potential environmental, economic, and social benefits of utilizing organic waste instead of landfilling it.
- Identify opportunities to utilize organic waste and divert it from landfills.
- Actions on re-purposing our waste streams.
- Learning more about opportunities in the sector.
- Is diverting organic waste from landfill to compost viable from an environmental and financial perspective?
  - To understand the opportunities and how government programs may be able to assist.

**Listening & Learning**

- Every year thousands of tons of biological wastes are created in the seafood processing industries which could be the potential sources for product development to valorize these wastes and save the marine environment. I expect this forum will search for those opportunities and coordinate to reduce the environmental pressure for the forthcoming generation.

- Introduce our new marine ingredients site and capacities and share a few stories.



- Discuss the potential value-added opportunities, and solutions to obstacles that are relevant to aquaculture sourced organic byproducts.

- What are the current volumes, and future expected volumes of agriculture & aquaculture waste, solids and liquids?

- Are there any partners in the agriculture or aquaculture business who wish to work with and help fund a pilot to move to composting this waste?

## Ocean and Marine

- Available resources, and opportunities to divert organic waste to agriculture as nutrient inputs.

- Organic waste segregation, handling, and product (for example compost) delivery to farmers, communities, and household gardeners.

- I would like to see if there are people in the province interested in proper composting of wastes and their application to soils in a non-toxic, environmentally conscious effort.

- I would also like to know how much people in the province are thinking about soils in relation to organic wastes (given the poor nutritional qualities often found in our soils).



- Ideas about how to revitalize our composting area, streamline waste material collection/storage options, introduce large(r) scale vermiculture operations, and anything that would bring us closer to our goals to amend our own spent soils for reuse, and eventually create new engineered living soil recipes as a commercial product.

## Agriculture, Farming & Soil

- I'd like to hear about opportunities for forests sector wastes (residues) to be adopted as inputs in other processes/industries (waste to value). I'd also like to hear perspectives on barriers to moving waste to value effort forward (esp. with respect to the forest industry). Our BioEcon project has some capacity to explore policy barriers and will also be exploring the skills/training needed to help facilitate the bioecon transition; skills/training to support waste to value is part of this.



- Networking with entrepreneurs to develop business opportunities for wood biomass.

## Forestry

- Connections for potential research partnerships
- To meet and hear from other companies/organizations involved in food waste (i.e., reducing, repurposing etc.).
- Potential opportunity to network with different organizations and communities.
- Getting exposed to all of the "players" in ICI organics
- New connections and a handful of possibilities.
- Opportunity to network
- Network with representatives in various industries to build relationships and possibly work together for a common goal of waste diversion.
- Networking and better understanding the potential to increase food security by reducing waste.
- Meeting key people who are keeping materials in use and learning what can be put into action in the Northeast Avalon communities.
- New contacts for people looking to develop the sector.
- Motivation/support to incorporate these values into my business and contacts.
- Networking with suppliers

## Network Building Creating a Foundation for Working Together



- Starting a plan on how we can find a workable solution to this problem. What steps are required? and how can we get the work done?
- Composting has been on Central Waste Management radar for about 10 years now, opportunities are there for an opportunity to convert a waste to a resource valued product..  
How do we move forward, and who will lead the charge?
- A commitment from Government, Industry and Academia to work together to create a provincial strategy to minimize organic waste and create value for the benefit of NL communities. This could start with a working group or committee tasked with identifying key stakeholders and holding a series of stakeholder consultations to identify opportunities and challenges for the development of an organic waste-to-value approach.
- A discussion of opportunities to coordinate between the sectors with respect to organic wastes.
  - Integrated approach across regions and waste types
- A commitment from government to actually advance policy in this area to allow an industry to establish and grow.
  - Potential partnerships in the NL region that may collaborate on an intensive, integrated approach to organic waste management.

# Community Connections

- Networking/connections and resources to implementing/operating community waste reduction - including sustainability plans.
- What role is most suitable for the municipality in this process.
- Potential collaboration between relevant industries and municipalities, opportunities for cost-sharing.
- I am hoping to learn more about how Cohousing NL could play a role in managing organic waste and opportunities that exist in the province for innovation from a social enterprise perspective. I'd love to learn more about how community-led development projects could incorporate innovative organic waste-to-value principles in their design.
- Identifying opportunities that can benefit rural communities.



# Research & Commercialization

## And a few final specifics...

- Answers to why we do not currently have organic separation, and what is required to start.
- I would like to know why Anaerobic Digestion of Organic Waste was not considered before. Anaerobic Digestion and a Combined Heat & Power plant is used recover Energy from Organic waste. The energy is used for domestic and commercial heating in other parts of Canada.
- Advice and direction on obtaining funding for our project and future expansion of this project (equipment, testing, PPE, consulting fees, etc.)



### **Organics Waste-to-Value Forum 2022**



# Appendix E – Handout 2: Knowledge & Experience

Containing Participant Responses to Pre-Forum Question,  
“What is your knowledge and experience with organic waste or “waste to value” strategies”?



## WE ASKED...

*What is your knowledge and experience with organic waste or “waste to value” strategies?*

- At Ever Green recycling, we are currently dealing with organics on a small scale and so far have been successful, to certain extent.
- I have some ideas on the use of food waste - either vermicompost or just composting. I have recently watched some documentaries on how small towns have made sustainable income out of organic waste, which I can share.
- I currently manage a R&D Centre with a research focus on marine bio-processing to minimize fisheries and aquaculture waste by extracting more value from fish/aquaculture by-products. My team has developed strategies for creating value from marine waste, including crustaceans, salmonids, cod, sea cucumber. I am also about to submit (April 2022) my PhD thesis: "A Green Chemistry and Ocean Based Biorefinery Approach for Valorization of NL Snow Crab Processing Discards."

## ...YOU ANSWERED



- I'm a green chemist, providing value added products from waste streams is apart of my expertise!
- I have been working in the bioeconomy within the forestry realm for at least the last 8 years. I have been focused on the use of boiler ash at Corner Brook Pulp and Paper as a liming replacement or fertilizer for forestry or agricultural purposes. I have been involved with ash testing, join research with Grenfell-MUN on ash applications and the Ashnet - a national ash research group for forestry applications. I have also conducted my own ash work for forestry applications.
- I oversee the Provincial Solid Waste Management Strategy, and manage waste management infrastructure funding available for regional waste management initiatives through Regional Service Boards/municipalities.
- About 8 years in marine biomass base processing. Founding collaborator on the Grenfell MBI initiative. Direct a research budget within the MBI framework on our scope of work

## ORGANICS WASTE-TO-VALUE FORUM 2022



- Founder NL marine organics, installing a marine biomass plant at Windy Heights Farm, PCSP. Hydrolysates and bio-marine separations. Can comment on the value chains and work involved to turn waste into value.
- Over 15 years, I have supported aquaculture, and contributed ideas and solutions to managing organic by-products that are routine as well as large. I have helped facilitate R&D, early commercial, and commercial projects between producers and service providers, as well as between aquaculture and agriculture. I am familiar with the handling, treatment, storage, and recovery of these materials. I have a perspective to offer on what has worked reliably at a commercial scale and ongoing challenges.
- I have theoretical knowledge of municipal and industrial waste types and management options. Currently, our research team and our partner (farmer) are designing engineered soil using a local community organic waste and greenhouse spent potting soil using vermicomposting process, ongoing trial.
- Have done work in aquaculture-related waste streams and was involved with adoption of regional waste management strategy for Southern Shore.
- While working on Marine bioprocessing area, identified that waste resources have more economical potential compared to main product.
- Organic farming with berry crops.
- Through our BioEcon project I have learned about assets of forest industry residues that are either disposed of or utilized with very little value added. I have also learned about the interest among mill owners in seeing higher value applications of their residues and, perhaps more importantly, in partnering with other non-traditional parties to support regionally impactful projects.
- Participating in engineered soil project with MUN - objective of this project is to divert local community (household, cafes, grocers) and environmental (seaweeds, green crab) wastes to be used in our composting/vermiculture operations - then used to amend our spent soils from greenhouse cultivation production. We have been successful in making community connections to source, collect, and store large volumes of waste material (eggshells, coffee grounds, food scraps, seaweed, green crab).
- I have experience in the area of organic wastes from the aquaculture and fish processing industries, as well as knowledge of anaerobic digestors, ensilage, and composting of organics. I have some background on the logistics of waste management in rural communities.

**your knowledge, skills, and experience**

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**ORGANICS WASTE-TO-VALUE FORUM 2022**

- Director - Agriculture Production and Research, Dept. of Fisheries, Forestry and Agriculture
- CNWM has reviewed a number of residential composting options, and we have participated with and discussed commercial activities that can provide a value added to composting on a regional/provincial level.
- We have created a community partnership with rural community, found infrastructure funding for community-scale digester (including power and collection equipment), and brokered opportunities with municipalities to begin community-wide waste diversion strategy. But we need to make operational and ensure sustainable funding streams in place. Critically, we need to review how best to structure the operation in terms of non-profit/co-op/CDC.
- Impact of organics on climate change, current framework of waste management at the City of St. John's.
- Specialize in waste management plans
- Sea cucumber waste (internal organs such as gut material, respiratory trees, gonads and body fluid) which is account for about 15-20% of body weight passes to the ocean from the processing industries. Sea cucumber waste has a good potential for nutraceutical and pharmaceutical product development which can generate extra revenue for the main products and increase competitiveness in the world market for the NL sea cucumbers. It will also save the marine environment.



- I've been part of the dialogue and strategic initiatives on organic utilization in the aquaculture industry for many years.
- As a waste management company, we may be able to offer perspective on issues affecting the industry and opportunities for change.
- Research and development in area of waste to value, repurposing wastes.
- I am the Manager of Environmental Science and Waste Management with the Pollution Prevention Division of the Department of Environment and Climate Change with responsibility of policy and regulatory framework for waste disposal, including organic waste.
- I oversee the City's waste management program, community gardens, and neighborhood composting programs.
- I am involved with the Cohousing NL cohousing community project - we have a large focus on permaculture and organic waste-to-value on the team so I am hoping several more experienced members are able to attend this as well. I can offer experience with social enterprise and the high-level plans we have.
- I am familiar with the provincial and regional waste diversion targets and realize the challenges with organic waste diversion. Familiar with the processes and costs structures involved in organic waste diversion programs and our own blue bag recycling program.

- Have conducted applied research with NL companies to assist with waste management challenges.
- Knowledge in research-academia collaborations and intellectual property.
- Environmental Scientist responsible for Organic Waste Management with Pollution Prevention Division of Provincial Department of Environment & Climate Change in NL.
- I'm chairperson of the Burin Peninsula Regional Services Board. This board is responsible for waste management for the Burin Peninsula. We handle both municipal and commercial waste. We presently operate a small compost facility and process municipal organic waste from a small portion of the peninsula. We also process organic waste from a local grocery store some fish waste from local processing plants. Our board also composts green crab and moose carcass from roadkill.
- I am involved with the funding and management of waste management projects throughout the province and have an understanding of the waste management policies in the province.
- I have a manufacturing background with an accounting skillset. This can be useful for commercializing ideas that others may have or for testing feasibility of ideas.
- I serve as General Manager of the Burin Peninsula Regional Service Board. As part of our operation, we conduct a number of waste diversion programs, including a windrow composting system with commercial drop-off and residential curbside collection. We are also currenting in the process of developing an enhanced system for septic sludge and industrial organic materials.
- I'm a Zero Waste/Circularity consultant. I run a community composting program in St. John's and I'm in conversations with two neighbour communities about how the built environment can connect with agricultural land through the management of organics. I also contributed with a circular framework, learning from the Circular Food System in Guelph-Wellington, ON, to the Strategic Agricultural Plan for the Killick Coast Region led by the Chamber of Commerce of Portugal Cove-St. Philip's.
- Mechanical engineer. Researching other waste streams and how to use them more effectively.
- Waste to value streams and plans within the agriculture industry.
- Use of wood ash as soil amendment. I have hands-on experience in bio-tech and wish to network and offer my experiences.
- I have hands-on experience in bio-tech and wish to network and offer my experiences.

your knowledge, skills, and experience

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**ORGANICS WASTE-TO-VALUE FORUM 2022**

- Personal knowledge and experience having grown up in Nova Scotia where residential organic separation has been happening for decades. Can offer insights into implementing on-site commercial composting process.

- I am an experienced soil scientist with a specialization in soil respiration and have knowledge about the effects of wastes on soil and what processes they can stimulate/suppress. I also have experience with composting on small to large scales and went through the Maine Compost School's week-long programme designed to teach farmers and professionals how to manage their waste streams. I am a PhD student at MUN and have worked with many farmers over the course of my career.

- I have worked with Municipal Governments in Kerala, India to establish waste management systems that focused on Community Composting; conducted training sessions for Home Composting. I am a member of Zero Waste Action Team of Social Justice Cooperative N; a Youth Ambassador for a global campaign movement Break Free From Plastic; and am connected to global networks that focus on Organics Management in Zero Waste Practises.

- I have a good bit of local economic analysis and modelling experience in NL and hope to learn how different tools and modelling frameworks may be leveraged to help address the practical needs of the field and community in this area.

- Owner of the leading company in Atlantic Canada and a proprietary circular economy business model that is transforming organic waste management and manufacturing practices in the fish, farm and forest sectors, globally

- I have been teaching backyard composting for 14 years and have had many discussions with various people from homeowners to farmers, to industry professionals. I love being able to make connections between groups who have a need, and others who have something to offer. I offer environmental education sessions for all ages, and love to be able to tell people about the good that is happening in our community.

- From a government perspective contribute info about programs/other possible resources/pathfinding. Learning about industry issues/opportunities etc and how to assist the sector going forward.

- We have taken municipal wastewater, provide full treatment, capture, mineralize and compost the sludge into a reusable product.

- We generate carbon offsets to sell from the process taking a waste and turning it into a reusable product. I would like to investigate if this can also be done for agriculture and aquaculture waste.



## Appendix F – Handout 3: Memorial Assets

Containing Memorial researchers responses to the question,

"What are some of the organics waste-to-value research and related assets currently available at Memorial University?"

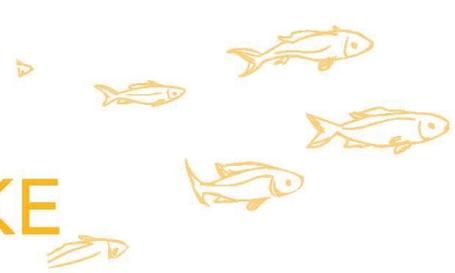
# ORGANICS WASTE TO VALUE FORUM 2022

## MEMORIAL UNIVERSITY RESEARCH ASSETS

We asked our researchers to share with us some of the assets currently available at Memorial University such as research interest, projects, and publications.

Here is a brief overview of the responses we received.





## HEATHER BURKE

Heather Burke has a broad experience in applied research spanning more than 2 decades with major emphasis on marine bioprocessing and the development of value chains of unutilized marine biomass materials. Most recently she has worked on several crustacean bio-extraction and bio-conversion projects using marine discards as feedstock for nutraceutical, biomedical and bioscience applications. She is currently writing her Ph.D. thesis (Environmental Science) with an expected completion of Spring of 2022. Her thesis research focuses on using green chemistry and an ocean based biorefinery approach for the valorization of NL snow crab processing discards and the challenges associated with attaining full utilization of this raw material. She is currently seeking industry partners and funders interested in optimizing green technologies for utilization of snow crab discards and producing product samples (e.g., pigmented oils, chitin) on a pilot scale.

During her 15+ years as the Director of the Marine Institute's Centre for Aquaculture & Seafood Development she has been involved in more than 200 industry based research projects related to the characterization and valorization of marine waste and has worked with a variety of species (cod, shrimp, crab, sea cucumber, lobster, salmon, mussels, seal, BSF) to identify and develop new applications/products for these potential feedstocks ranging from compost to aquafeed and pet treats, to dietary supplements and cosmetic applications, and other bio-products for use in medical devices and as bio-conductors. She manages a team of 15 research and technical personnel (research scientists, biotechnologists, engineers, seafood processing technologists, and lab technicians), 2-pilot plants, and an analytical lab that support these research activities. Her team has developed an innovative enviro-friendly method for the pilot scale extraction of chitin and protein from shrimp shell waste. They currently have one post-doc, and several graduate students and student interns involved in various industry-driven marine waste valorization projects working within the Centre.

Please refer to the Marine Institute's Centre for Aquaculture & Seafood's website for a list of recent publications:

<https://www.mi.mun.ca/departments/centreforaquacultureandseafooddevelopment/publications/>



## DR. DEEPIKA DAVE

Dr. Deepika Dave is a Research Scientist in the Centre for Aquaculture and Seafood Development (CASD) at the Marine Institute of Memorial University of Newfoundland. Dr. Dave has over 22 years of increasingly responsible experience in engineering, science, management, research, training, and facilitation. Dr. Dave specializes in the areas of marine bioprocessing and bioconversion, blue biotechnology and waste Utilization (including production of high value molecules such as nutraceuticals, cosmetics and pharmaceuticals from marine unutilized resources (both on a small and pilot scale), environmental engineering (including waste characterization, water/wastewater treatment, management and utilization, remediation of contaminated air, water and soil) and energy production and management (including characterization of biomass, size reduction, production of bioethanol and biodiesel). She is a principal investigator for the delivery of the product and process design, industrial and development services at the Marine Institute's Marine Bioprocessing Facility.

### Selected Publications

- Liu, Yi and D. Dave (2022). Recent progress on immobilization technology in enzymatic conversion of marine by-products to concentrated omega-3 fatty acids. *Green chemistry*. 24: 1049-1066.
- Brown, P and D. Dave (2022). Current freezing and thawing scenarios employed by North Atlantic fisheries: Their potential role in Newfoundland and Labrador's northern cod (*Gadus morhua*) fishery. In press.
- Liu, Yi and D. Dave (2022). Enzymatic hydrolysis of Atlantic salmon (*Salmo salar*) by-products using immobilized Alcalase on chitosan-coated magnetic nanoparticles. *Aquaculture*, 548 (737546).
- Liu, Yi, D. Dave, S. Trenholm, V. V. Ramakrishnan and, W. Murphy (2021). Effect of Drying on Nutritional Composition of Atlantic Sea Cucumber (*Cucumaria frondosa*) Viscera Derived from Newfoundland Fisheries, *Processes*. 9(4), 703.
- Ramakrishnan, V.V., D. Dave, Y. Liu., W. Routray and w. Murphy (2021). Statistical Optimization of Biodiesel Production from Salmon Oil via Enzymatic Transesterification: Investigation on Effect of Various Operational Parameters. *Processes*. 9(4), 700.
- Senadheera, T.R.L, D. Dave and F. Shahidi (2021). Antioxidant potential and physicochemical properties of protein Hydrolysates from body parts of North Atlantic sea cucumber (*Cucumaria frondosa*). *Food Production, Processing and Nutrition*, 3:3.

- Liu, Yi, V. V. Ramakrishnan and D. Dave (2020). Lipid class and fatty acid composition of oil extracted from Atlantic salmon by - products under different optimization parameters of enzymatic hydrolysis. *Biocatalysis and Agricultural Biotechnology*, 30, 101866.
- Dave, D., Y. Liu, J. Pohling, S. Trenholm, W. Murphy (2020). Astaxanthin recovery from Atlantic shrimp (*Pandalus borealis*) processing materials. *Bioresource Technology Reports*, 11,100535.
- Senadheera, T.R. L., D. Dave and F. Shahidi (2020). Sea Cucumber Derived Type I Collagen: A Comprehensive Review, *Marine Drugs* 2020, 18: 471; <https://doi.org/10.3390/md18090471>
- Hossain, A., D. Dave and F. Shahidi (2020). Northern Sea Cucumber (*Cucumaria frondosa*): A Potential Candidate for Functional Food, Nutraceutical, and Pharmaceutical Sector. *Marine Drugs*. 18(5):274
- Gajdosechova, Z., C. Palmer, D. Dave, G. Jiao, Y. Zhao, Z. Tan, J. Chisholm, J. Zhang, R. Stefanova, A. Hossain, Z. Mester (2020). Arsenic speciation in sea cucumbers: water-extractable species. *Environmental Pollution*. <https://doi.org/10.1016/j.envpol.2020.115190>.
- Liu, Yi, V. V. Ramakrishnan and D. Dave (2020). Enzymatic hydrolysis of farmed Atlantic salmon waste resources: Investigation of operational parameters on extracted oil yield and quality. *Process Biochemistry*, 100, 10-19
- Dave, D., Y. Liu, L. Clark, N. Dave, S. Trenholm and J. Westcott. (2019) Availability of marine collagen from Newfoundland fisheries and aquaculture waste resources. *Bioresource Technology Reports*, 7:1-8
- Dave, D. and W. Routray (2019) Fishery byproducts: recovery of high value nutritional components. Reference Module in Food Science. ISBN: 9780081005965, <https://doi.org/10.1016/B978-0-08-100596-5.22588-2>
- Routray, W., Dave, D., S. K. Cheema, V.V Ramakrishnan and J. Pohling (2019). Biorefinery approach and Environment-friendly extraction for sustainable production of astaxanthin from marine wastes. *Critical Reviews in Biotechnology*. 469-488.
- Dave, D., J. Pohling and W. Routray (2019). Marine Oil as Biodiesel. *Edible Oil and Fat Products: Industrial and Nonedible Products from Oils and Fats*, Bailey's Industrial Oil and Fat Products 7th Edition.



## DR. STEPHEN DECKER

Dr. Stephen Decker is the principal investigator for the NLWIC funded project entitled “Forest-based Bioeconomy Development in Newfoundland”. This research project aim to identify opportunities for forest-based product diversification as well as for partnerships with other organizations and resource sectors which can avail of the forest industry-related assets such as forest residues, waste heat, and workforce skills. This work is focused on 5 forest-based regions on the island of NL. To date, saw or pulp and paper mills and associated stakeholders in 4/5 case study regions have been consulted and the research team has leaned of a variety of forest industry residues and other assets of interest to local, regional, and provincial stakeholders who have developed early-stage ideas and proposals for how these residues and assets can be adopted as resource inputs in support of new initiatives. Dr. Decker is supervising a PhD student (Lucas Garcia) as part of this project. Lucas's work is focused on examining how greater gender parity in NL's forest industry workforce can support the bioeconomy transition.

Dr. Decker also sits on a supervisory committee for a graduate student (Sean Goldstone) in the Master's in Environmental and Social Change (MESOC) program at the University of Winnipeg. Sean's tentative thesis title is "A comparative analysis of soil amendment policy and public-private-civic partnerships for climate adaptation in Newfoundland's renewable bio-resource sector". His work will focus on the policy barriers which challenge the use of forest, agriculture, and aquaculture residues as soil amendments in Newfoundland and Labrador. Sean will arrive in NL in May to begin data collection for his thesis.

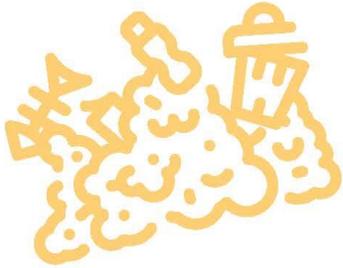


## DR. LAKSHMAN GALAGEDARA

Dr. Galagedara has been using different organic wastes [agriculture, forestry, fishery] to improve physicochemical properties of agricultural soils with the aim of improving soil health to increase agricultural land and water productivity and support food security targets. Examples: use paper mill by products such as wood ash as liming materials, sludge, and wood ash to develop and test potting media, convert sludge to hydrogels in order to improve water retention properties of podzolic soils.

### Selected Publications

- Farhain, M., Galagedara, L., et al (2022). J of Environmental Management, 301 (2022), 113811: 1–12. <https://doi.org/10.1016/j.jenvman.2021.113811>
- Arnott, A., Galagedara, L., et al., (2021). Science of the Total Environment, 775, 25 June 2021, 145139. <https://doi.org/10.1016/j.scitotenv.2021.145139>
- Ratnajit S., Galagedara, L., et al., (2020). Agriculture 2020, 10, 471. doi: 10.3390/agriculture10100471
- Maheswaran, G., Krishnapillai, M., et al., (2019). Canadian Biosystems Engineering, 61: 1.9 – 1.15. <https://doi.org/10.7451/CBE.2019.61.1.9>
- Vermooten, M., Galagedara et al., (2019). Agriculture, 2019, 9, 183; doi:10.3390/agriculture9080183
- Altdorff, D., Galagedara, L., Abedin, J., Unc, A. (2019). Soil Systems, 2019, 3, 53. <https://doi:10.3390/soilsystems3030053>
- Wanniarachchi, D., Galagedara, L., et al., (2019). Soil Systems 2019, 3(49): 1-12. <https://doi:10.3390/agriculture9060133>
- Wanniarachchi, D., Galagedara, L., et al., (2019). Agriculture 2019, 9(133): 1-12. <https://doi:10.3390/soilsystems3030049>



## DR. KELLY ANNE HAWBOLDT

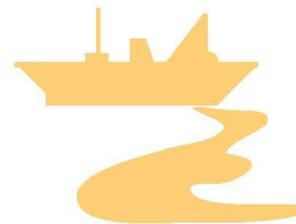
Dr. Hawboldt studies biomass residues including municipal waste, pulp and paper sludge, fishery processing by-product (aquaculture and wild harvest), forestry residues (sawmill residues, construction waste etc) and conversion to value added products by developing green processing methods (minimal energy used and waste generated). In addition, her team has co-mingled wastes from different industries to determine best processing options given; volume of waste; composition of waste; compounds in one waste stream that may benefit another. Her team have also developed products from these processes that can be used to treat another waste stream (e.g. biochar from forestry used a CO<sub>2</sub> capture for oil and gas and power industries). They are also studying biomass residues as a source of hydrogen.

### Selected Publications

- Ahmadekelayeh, S., Cheema, S. Hawboldt, K. Evaluation of Conventional Solvent Processes for Lipid and Astaxanthin Extraction from Shrimp Processing By-products, Chemical Engineering Communications, accepted Feb 2022 (in press)
- Ahmadekelayeh, S., Cheema, S. Hawboldt, K. Supercritical CO<sub>2</sub> Extraction of Lipids and Astaxanthin from Atlantic Shrimp By-products with Static Co-solvents: Process Optimization and Mathematical Modeling Studies, Journal of CO<sub>2</sub> Utilization, accepted January 2022 (in press)
- Ahmadekelayeh, S. & Hawboldt, K. (2020). Extraction of lipids and astaxanthin from crustacean by-products: A review on supercritical CO<sub>2</sub> extraction. Trends in Food Science and Technology, (103), 94-108. <https://doi.org/10.1016/j.tifs.2020.07.016>
- Hopkins, D.T., MacQuarrie, S., Hawboldt, K.A. Removal of copper from sulfate solutions using biochar derived from crab processing by-product (2022) Journal of Environmental Management, 303, art. no. 114270
- Hopkins, D., & Hawboldt, K. (2020). Removal of metals from solution: A review of lignocellulosic and novel marine feedstocks. Journal of Environmental Chemical Engineering, 8 (4). <https://doi.org/10.1016/j.jece.2020.103975>
- Krutof, A., & Hawboldt, K.A. (2019). Co-pyrolysis of softwood with waste mussel shells: Liquid analysis. Fuel, 254. <https://doi.org/10.1016/j.fuel.2019.05.167>

- Krutof, A., Bamdad, H., Hawboldt, K.A., & MacQuarrie, S. (2020). Co-pyrolysis of softwood with waste mussel shells: Biochar analysis. *Fuel*, 282. <https://doi.org/10.1016/j.fuel.2020.118792>
- Laprise, C.M., Hawboldt, K.A., Kerton, F.M., Kozak, C.M. (2021). Synthesis of a renewable, waste-derived nonisocyanate polyurethane from fish processing discards and cashew nutshell-derived amines. *Macromolecular rapid communications*, 42 (3), 2000339. <https://doi.org/10.1002/marc.202000339>
- Murphy, J.N., Schneider, C.M., Mailander, Q., Hawboldt, K.A., & Kerton, F.M. (2019). Wealth from waste: Blue mussels (*Mytilus edulis*) offer up a sustainable source of natural and synthetic nacre. *Green Chemistry*, 21 (14), 3920-3929. <https://doi.org/10.1039/c9gc01244c>
- Murphy, J.N., Schneider, C.M., Hawboldt, K.A., & Kerton, F.M. (2020). Hard to Soft: Biogenic absorbent sponge-like material from waste mussel shells. *Matter*, 3 (6), 2029-2041. <https://doi.org/10.1016/j.matt.2020.09.022>
- Phadtare, I., Vaidya, H., Hawboldt, K., & Cheema, S.K. (2021). Shrimp oil extracted from shrimp processing by-product is a rich source of omega-3 fatty acids and astaxanthin-esters, and reveals potential anti-adipogenic effects in 3T3-L1 adipocytes. *Marine Drugs*, 19 (5), 259. <https://doi.org/10.3390/md19050259>
- Hawboldt, K., Bottaro, C., Hopkins, D, Moore, S., 2018 R2. Green processing of waste aquaculture fish feed bags to fuel.
- Hawboldt, K., Rahman, S., Helleur, R. 2018 (for Provincial Government Materials and Management Stewardship Board)
- Harris Centre Report: Organic Waste in Newfoundland and Labrador: A Review of Available Agriculture, Fishery, Forestry and Municipal Waste Literature, 2017 (for Provincial Government Materials and Management Stewardship Board) R4. Risk-based Evaluation of Landfill Gas Flare Efficiency Using Computational Fluid Dynamics (CFD)
- Abbassi R., Hawboldt K., 2012, (for Provincial Government Materials and Management Stewardship Board) R5. Provincial Inventory of Forestry Biomass Residues and Lignocellulosic
- Hawboldt, Helleur, 2011, Government of NL R6. Biomass residues conversion technologies review
- Jayasinghe, Hawboldt, Helleur, 2011, Government of NL WASTE TO PRODUCT.
- Moshtagh, B., Hawboldt, K., Zhang, B. Biosurfactant production by native marine bacteria (*Acinetobacter calcoaceticus* P1-1A) using waste carbon sources: Impact of process conditions (2021) *Canadian Journal of Chemical Engineering*, 99 (11), pp. 2386-2397.

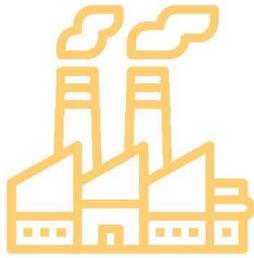
# DR. BAIYU (HELEN) ZHANG



Dr Baijy (Helen) Zhang's lab has generated fishery waste-based bioproducts (e.g., biosurfactants, biodispersants), which can be used for soil and groundwater remediation and marine oil spill response.

## Selected Publications

- Song, X., Chen, B., Liu, B., Lye, L.M., Ye, X.D., Nyantekyi-Kwakye, B., and Zhang, B.Y. (2022) Impacts of frazil ice on effectiveness of oil dispersion and migration of dispersed oil. *Environmental Science & Technology (ACS Publications)*. 835–844. DOI: 10.1021/acs.est.1c04014
- Moshtagh, B., Hawboldt, K. and Zhang, B.Y. (2021) Biosurfactant production by native marine bacteria (*Acinetobacter calcoaceticus* P1-1A) using waste carbon sources; impact of process conditions. *Canadian Journal of Chemical Engineering (Wiley)*. 99 (11): 2386-2397. DOI: 10.1002/cjce.24254
- Hu, J.H., Luo, B., Zhu, Z.W., Chen, B., Ye, X.D., Zhu, P., and Zhang, B.Y. (2021) Multi-scale biosurfactant production by *Bacillus subtilis* using tuna fish waste as substrate. *Catalyst (MDPI)*. 11(4): 456. DOI: 10.3390/catal11040456
- Moshtagh, B., Hawboldt, K. and Zhang, B.Y. (2021) Kinetic modeling of biosurfactant production by *Bacillus subtilis* N3-1P using brewery waste. *Chemical Product and Process Modeling*. DOI: 10.1515/cppm-2020-0118
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- Zhu, Z.W., Zhang, B.Y., Chen, B., Ling, J.J., Cai, Q.H., and Husain, T. (2019). Fly ash based robust biocatalyst generation: a sustainable strategy towards enhanced green biosurfactant production and waste utilization. *RSC Advances (Royal Society of Chemistry)*. 9 (35), 20216-20225. DOI: 10.1039/C9RA02784J



## DR. MANO KRISHNAPILLAI

Dr. Mano Krishnapillai is currently running two projects focusing on industrial waste utilization. The first one involves utilizing the waste ash generated by the paper mill for liming purposes in agriculture. Since contaminants are the major stumbling block in ash utilization, they are running controlled experiments to see if the contaminant movement in the soil can be controlled using biochar as soil amendment. The lab experiments show promise, and they are currently running outdoor experiments growing plants lysimeters. The second project involves trying to utilize the sludge and bark generated by mill processes using fungi for making compost. This on-going project is currently aiming to produce vermicompost from these resources.

### Selected Publications

- Potential for using paper mill fly-ash as an alternate liming material and mobility and leachability of heavy metals in fly-ash and biochar amended agricultural soil in Western Newfoundland. Master's thesis by Gnanakaran Maheswaran.
- Gnanakaran, M., M. Krishnapillai, D. Churchill, D and L. Galagedara, L. 2019. Fly-ash from a pulp and paper mill: a potential liming material for agricultural soils in western newfoundland. Canadian Bioengineering Journal 61:1.9-1.15 <https://doi.org/10.7451/CBE.2019.61.1.9>
- Co-composting of paper mill sludge and using the compost for bioremediation of petroleum hydrocarbon contaminants. Master's thesis by Allison Groenen

