Thompson Rivers University strives to be a more sustainable and progressive institution that works towards creating positive change to benefit the planet. TRU's follows the four pillars of sustainability which are, environmental, social, economic and cultural. It has become evidently clear that communities must come together and focus on sustainability initiatives that will benefit the health of the planet and ultimately the health of humans.

The Kamloops community has begun to progress in their sustainability initiatives by implementing a new Residential Organic Waste Collection program. This research project aims to assist the Residential Organic Waste Collection program by partnering with the City of Kamloops to collaborate and share the results that could be implemented to improve the program and city policies.

This project will be run under the guidance and supervision of Dr. Naowarat Cheeptham and Dr. Kingsley Donkor. This project seeks to answer if it is recommended to use cardboard in composting to enhance microbial diversity and reduce cardboard waste in landfills. As well as, this project will further look into if all types of cardboard are safe to use.

Composting is a natural process of recycling nutrients back into the soil that involves microbes like bacteria and fungi that decompose organic matter from food and plant waste and turn it into a usable fertilizer. Fertilizer has many economic benefits that fit into the circular economy model. Fertilizer that is rich in a diverse array of microbes will be a great advantage in the agriculture sector.

Compost improves soil nutrient retention, creating better soil conditions for agricultural purposes. Additionally, the soil microbiome can increase soil conditions and fertility (4). Compost with an increased microbial community composition balances the soil ecosystem and improves the health of the soil and plants (8). Many microbes share a symbiotic relationship with plants and aid in plant growth and yield, nutrient uptake and nutrient cycling. Therefore, having more bacterial and fungal diversity within the compost results in a preferable compost for agricultural use (8).

To set up the experiment for this project, composting will be done at TRU. A control treatment of compost that does not contain cardboard will be used to compare against compost that contains cardboard. There will be a test trial of compost that contains ink, glue and dye contaminated cardboard to see if these toxins have any effect on the microbial diversity and the compost products. Additionally, each test trial will also have a complementary trail that will have earthworms introduced to the compost. The addition of earthworms to create vermicompost will also be looked at to see if the microbial community differs.

For all test trials of cardboard and non-cardboard compost and vermicompost samples, microbial culturing methods will be used to observe the growth of the bacteria and fungi. Compost samples

will be spread plated on nutrient and potato dextrose agar. From these plates CFU will be counted to determine the amount of bacteria present in each sample, as well as Gram stains and methyl blue staining will be done to observe the bacteria and fungi present and determine the variation and similarities between samples.
To aid in the culturable results DNA will be extracted from each compost sample and sent to UBC for metagenomic sequencing. The results of the metagenomic sequencing will help determine the genera of bacteria and overall microbial diversity in each compost sample.

For this project a chemical analysis will also be performed on the compost samples and the cardboard itself using ICP-MS. The results of the ICP-MS will help to determine what elements are most common in the compost and cardboard, which may lead to further inquiries about how they may influence the bacteria and fungi present.

The overall goal of this project is to look at the influence different types of cardboard have on the microbial community in compost. The short term goals are to identify the elements found in different types of cardboard that contain ink, dye and glue which could potentially impact the microbes present in the compost. For more of an overarching goal, this project intends to reduce cardboard waste that would otherwise end up in landfills. As cardboard sits in landfills, it contributes large amounts of greenhouse gas emissions released into the atmosphere, which is a major contributor to climate change (5). Cardboard that does make it to recycling depots goes through the very intensive recycling process which requires large amounts of water by using a hydrapulper to break down the material (10). Some more long term goals of this project would be to potentially implement a vermicomposting system to Kamloops if the benefits of adding earthworms aid in the microbial diversity of the compost. Another long term goal would be to identify and isolate any bacteria that is able to break down the more toxic elements of cardboard like the iisobutyl phthalate which is a common chemical found in cardboard printing ink (1). Overall, the goals of this project is to have a direct impact on the City of Kamloops waste management. This project will provide the city with useful information and potential solutions and improvements that could be made to enhance their new Residential Organic Waste Collection program.

Little research had been done that analyzed the impacts adding cardboard to compost has on the microbial community. Many local composter and other municipalities say that adding cardboard to food waste bins intended to be turned into compost is beneficial for moisture and smell control. In terms of the microbial community we also expect that the addition of cardboard will have a positive influence. We predict that the addition of cardboard to compost will increase the microbial diversity, which has the potential to make a better compost produced for agricultural purposes. With the addition of earthworms to the compost we predict that this addition will also increase the microbial diversity by introducing microbes present in the gut of earthworms. The results for the different type of toxic ink, dye and glue cardboard, we suspect to see lower or the same microbial diversity compared to the non-toxic cardboard compost.

If the results of this study show an increase in microbial diversity with the use of cardboard in composting then the city of Kamloops will continue their initiative in telling residents to add cardboard layers in between their home organics bins and create a new movement to encourage the use of cardboard in composting as a way to reduce the amount that ends up in landfills. The hope is that a report will also be published in a scientific peer-reviewed journal and that the results will be shared at the American Society of Microbiology conference in 2025.

This project is a community driven research project and the results of the study will have a direct impact on the City of Kamloops Residential Organic Waste Collection program and local residents. This study has the potential to impact neighboring communities that may also be interested in reducing cardboard waste in their landfills by sharing the results of the project. The results of this experiment will also shed light into the limited research on how cardboard influences microbes in composting. The results will help the city of Kamloops determine if recycling cardboard is the only way to dispose of it or if composting it is another alternative with additional benefits.