Con·sum·pla·tion

/känsuhm-pleyˈplāSH(ə)n/

noun

The action of looking thoughtfully at a consumption and anthropogenic impacts on the environment. Contemplating Consumption.

By Daniel Hanks

A THESIS SUPPORT DOCUMENT SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF MASTER OF DESIGN, INDUSTRIAL DESIGN

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Abstract

Inspired by principles of sustainable design, slow design, and minimalism, this thesis support document and the accompanying gallery exhibition titled *Consumplation* contain concepts that aim to improve the human condition while balancing individual, socio-cultural and environmental needs. This document and exhibition feature a range of subjects including an approach to implementing cricket farms in rural Zambia, a mobile application for converting North American grass turf (lawns) into sustainable farms, and molds for manufacturing roof tiles from recycled plastic.

The goal of this thesis project and exhibition is to focus on defining a design approach which promote the creation of products and services which reduce consumption leading to the destruction of our environment. The case studies in *Consumplation* follow a theme of anthropogenic activities with negative environmental impacts. Understanding the needs of individuals and communities featured in each case study helps to address activities with negative environmental impacts. The concepts in *Consumplation* are an opportunity for design students, and people in general, to develop skills and practices to improve the human condition.

Keywords
Sustainable Design, Industrial Design, Slow Design, Service Design, Habitat Loss, Food Security, Waste Diversion, Sustainable Development, Zambia,

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Introduction

Consumplation is a way for me to better understand my own approach and, at some level, a way for me to create a more efficient system for myself and others to consider when balancing the needs of individuals, their communities, and the environment. This research is about finding and exploring opportunities in which design thinking can be used to stimulate sustainability. To gain experience processing the complex context in which products and services are created, I conducted three separate case studies to gain exposure to a variety of scenarios. After each case study, I reflected on what I learned during the project. The reflections have also helped to discover new opportunities while refining my design approach. Each new case study brings my design approach closer to a balance between applying my existing skillsets, learning new skills, and contributing to worthy projects. *Consumplation* also leads to opportunities for further exploration which could be used to teach others processes like the development of business models, 3D modeling, and the design of compression molds.

Creative-Reflective Process

Through this study, I learned that my research system and creative-reflective process included creating inventories to comprehend and address the scale and complexity of a problem. The creation of inventories often included collections of lists, photos and physical artifacts. Some of the lists that I compiled include behaviors that are causing harm, human-needs which drive those harmful behaviors, and alternative ways of addressing those needs. I also, explored existing products, value propositions, and key partners. I have drawn on all these inventories in combination with my personal, professional, and academic experiences to create prototypes and concepts for new products and services which address activities with negative environmental impacts.

Timeline

This document begins with my background and the experiences that have shaped my design philosophy; then it illustrates how my practice-related research and development technical skills contributes the creation of prototypes and the discovery of design opportunities. Afterwards, this document covers the three case studies where I examine human behavior contributing to the destruction of habitats, probe forces behind those behaviors, and test products and services for changing the observed behavior. The following chart (see figure 1) is used to represent a timeline of events related to this study.

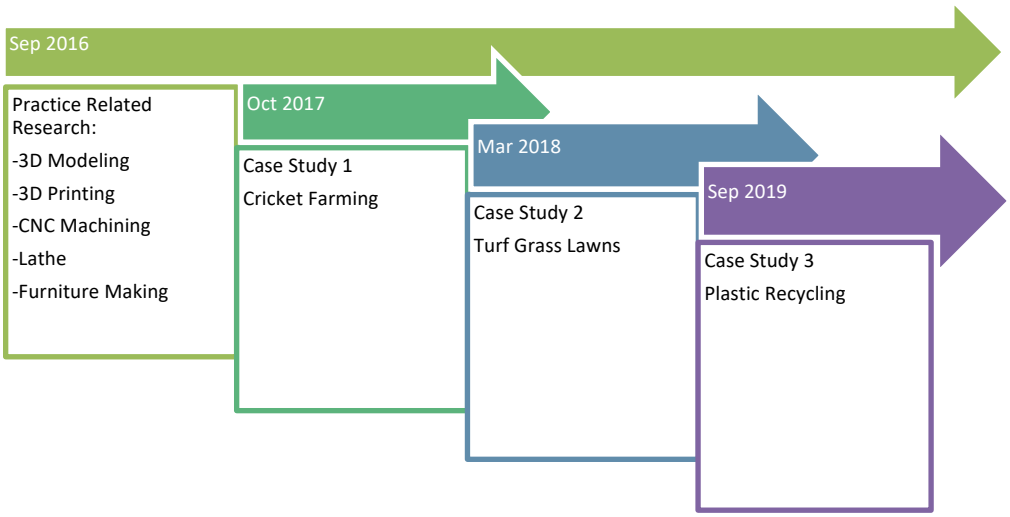

Figure 1 Consumplation Timeline

Background

Consumplation is heavily influenced by my professional, academic and personal experiences, both from living in Zambia from 2012 to 2015 and my subsequent work as a sustainability scholar and teaching assistant at the University of Alberta.

Living in a rural community in Zambia was a true experience of minimalism (see image 1). Two years with limited cellular service and exposure to media was a break from being bombarded by advertisements and a culture of consumerism. I had no running water and no electricity but living without these elements helped me realize that I had subconsciously subscribed to the idea that happiness can be found in the accumulation of physical objects—in possessing the newest trends. Breaking free from modern culture gave me an opportunity to experience happiness without being controlled by my attachment to objects. It was an opportunity to build relationships and experiences that never would have happened if I had clung to possessions and the place I previously considered home. This experience led to my interest in creating objects and services that contribute to people's basic physiological needs. I am specifically interested in projects that increase access to food, water and shelter. These interests are also influenced by projects I worked on while in Zambia and while at the University of Alberta.

Image 1 Hanks, Daniel; "Machamba Home" Northwestern, Zambia 2013

My work in Zambia focused on improving the efficacy of community-based workers. For two years, as a Peace Corps volunteer, I taught English in a Zambian Primary school. Afterwards, I used that experience to improve services and structures in Zambian community schools. While working for Education Development Center (EDC), I helped develop and test a suite of ICT-mediated training[1], coaching, and assessment tools for supporting teachers, principals and ministry employees in making sustainable improvements in reading.

Through work done with the University of Alberta, I worked with Sustainability Scholars in conjunction with the City of Edmonton, I performed a feasibility study to identify and test low-maintenance planting techniques and edible plant species suited for public parkland. As a teaching assistant at the University, I guided undergraduate students through ideation and prototyping processes while using 3D modeling software, 3D printing, CNC machining, and traditional woodworking methods.

[1] **ICT-mediated instruction** refers to instruction delivered via a technological channel such as television, radio, or a computer and network. ICT-mediated instruction can be synchronous, with both the instructor and the student participating simultaneously. [17]

Practice Related Research

I came to the University of Alberta Industrial Design program wanting to explore and expand my skills beyond my previous experiences in education and international development. I wanted to learn to make 3D models and physical products, so I began by learning to use equipment and tools I was unfamiliar with. Some of the processes I learned include: 3D modelling, 3D printing, wood turning, CNC milling[2], vacuum forming, planing, and jointing.

To learn how to use a lathe, I spent time turning blank pieces of wood without a precise plan or drawing. I explored a variety of mark making techniques on different sizes and types of wood in order to be knowledgeable about and comfortable around the machine when the time came to make something specific (image 2, 3). I turned at least 100 dowels from scrap wood to ensure using the machine felt natural. While turning wood on the lathe I learned several things that I didn't even know to ask before I started. Some of the things that I learned while using the lathe were how much time it takes to turn a part, which species or variety of wood is easier to turn than others, which shapes are easiest to make, when tools need to be sharpened, and how much pressure to put on the workpiece. I did not go into the shop with all of these questions. However, more questions came with every artifact created. While I was comfortable using the tool, there were always new things to learn and techniques to master.

Image 2 Hanks, Daniel "At the Lathe" 2017

[2] **CNC milling**, or computer numerical control milling, is a machining process which employs computerized controls and rotating multi-point cutting tools to progressively remove material from the workpiece and produce a custom-designed part or product. [18]

Image 3Hanks, Daniel "lathe works" 2017

My approach was similar with the CNC and 3D printing. The first goal was to learn how to safely use the machine, not to make a specific object (image 4). Reflection on the created artifacts inspired the next iteration of form making. Each time I used the machines, I pushed myself to create something more complex. Then I started to come up with specific designs that I wanted to fabricate with each machine. Eventually I started creating objects that used a combination of several processes.

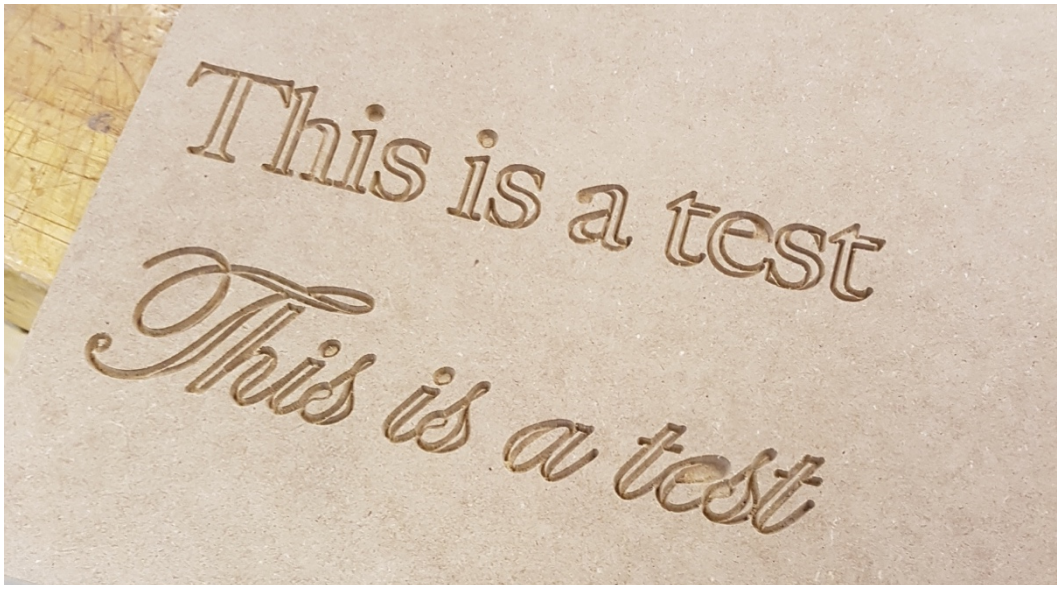

Image 4 Hanks, Daniel "CNC Engraving Test" 2017

The ideas for physical prototypes featured in *Consumplation* came from an inventory of seemingly random artifacts. However, these artifacts contributed to improved manufacturing techniques. After reflecting on the outcomes of these physical artifacts, ideas developed into more purposeful objects. This process of artifact making lead to a more developed concept named the *Bashiwa Bar Stool* (see Image 5) that is featured in the gallery exhibition (see appendix 1).

Image 5 Hanks, Daniel "Bashiwa Bar Stool"; Digital Render 2018

Case Studies

Case Study 1 - Cricket Farming for Food Security

Background

This case study draws on literature reviews and personal experiences from living in rural Zambia to explore increasing food security and income generating activities in rural Zambian communities through cricket farming. If a community outreach program taught the necessary skills to make cricket farming an adequate source of food and income, it could discourage practices that threaten biodiversity in Northwestern province (see image 6). The rationale for exploring this case study was related to the opportunity for improving the sustainability and reliability of food access through using design thinking.

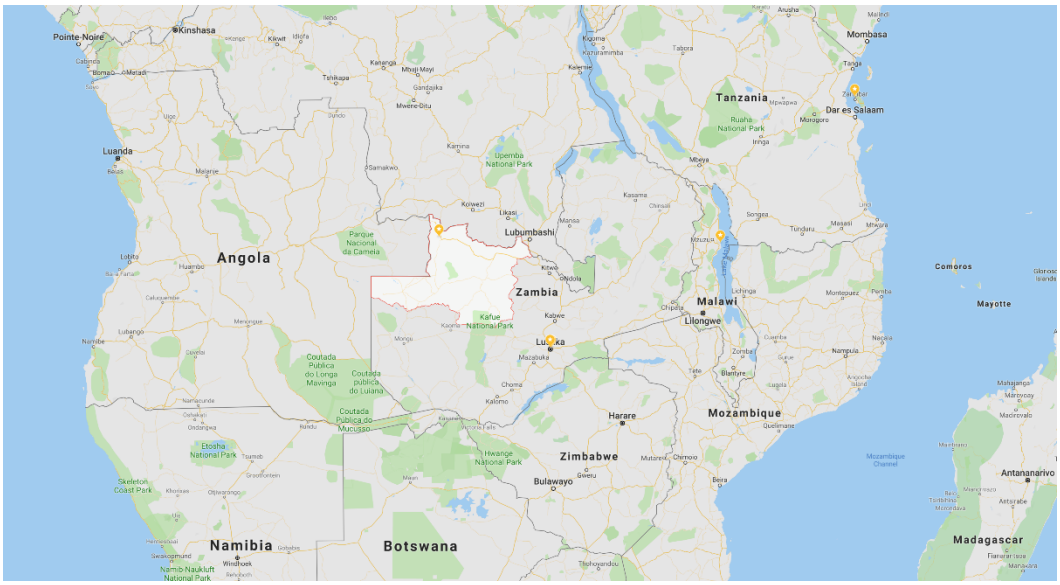

Image 6 Map data ©2019 Google; Northwestern, Zambia

Food Security

In Zambia, biodiversity is an essential source of food, nutrition and vitamins, especially to rural households [1]. Undernourishment and severe food insecurity appear to be increasing in almost all regions of Africa, as well as in South America, whereas the undernourishment situation is stable in most regions of Asia [2]. Food security exists when all people, at all times, have physical and economic access to sufficient [3], safe and nutritious food to meet their dietary needs for an active and healthy life. However, anthropogenic activities have contributed to unprecedented levels of biodiversity loss in the last few decades [4].

Rural Livelihood

When I wasn't teaching at Kampemba Basic School, while living in Machamba village (in Zambia's Northwestern Province) from 2012 to 2014, I spent time with my neighbors. Living with a Zambian family near Machamba village, revealed the many challenges associated with the lack of food security. Many daily activities which are essential to the families' livelihood also have a detrimental impact on the area's biodiversity. These observed activities include foraging, hunting, fishing, the making of charcoal, and the extraction of timber.

Foraging, Hunting & Fishing

Families in rural areas like Machamba live as subsistence farmers but rely heavily on foraged foods for protein. A loss of biodiversity could disrupt foods that rural Zambians rely on. While living in Machamba, I participated in activities that provided an important part of the community's diet: collecting caterpillars, catching mice and fishing.
Other seasonally hunted or foraged foods near Machamba include flying termites, grub worms, mushrooms, bush fruits, crickets, birds, and occasionally larger game (pangolin, kudu, and monkey). Some methods used to collect food necessary for survival threaten the habitats in which the food is foraged. The following are practices that I witnessed:

Tree cutting for Caterpillars

At the end of the rainy season, women of Machamba harvest caterpillars. During a two-hour harvest, a family can cut down as many as twenty trees (see image 7-11). The chief has asked people not to cut down trees while harvesting caterpillars, because he is aware of the threat of deforestation caused by this practice. However, caterpillars are a free source of protein, and community members have few alternatives, so the practice hasn't stopped. To support this personal observation, a Food and Agriculture Organization of the United Nations (FAO) study conducted in 2017, found unsustainable caterpillar harvests in remote parts of Zambia's Northwestern province are posing a serious threat to forests, with trees being felled to facilitate collection. [5]

Image 7 Hanks,Daniel; "Out for Caterpillars"; Northwestern Province Zambia, 2013

Image 8 Hanks,Daniel; "Chopping Trees"; Northwestern Province Zambia, 2013

Image 9 Hanks,Daniel; "Caterpillar Types"; Northwestern Province Zambia, 2013

Image 10 Hanks,Daniel; "Pot of Caterpillars"; Northwestern Province Zambia, 2013

Image 11 Hanks,Daniel; "Dinner Time"; 2013

Slash and Burn for Hunting Mice

During the dry season, young boys, hunt mice by burning tall grass which hides the burrows of mice (see image 12). Once burrows are found, the boys catch the mice by digging them out. The uncontrolled burns of this hunting technique can indiscriminately kill nearby fauna.

Image 12 Hanks,Daniel; "Good catch"; 2013

Fishing with Mosquito Nets

Some members of the community use donated mosquito nets intended for malaria prevention, as fishing nets. Literature suggests that fishing with mosquito nets has led to reduced fish populations. The ultra-fine netting of mosquito nets, often coated in insecticide, does not allow small fish spawn to escape [6].

Income from Making Charcoal & Timber Extraction

In remote areas like *Machamba*, the common practice is to use large and freshly cut timber for all cooking. In rural towns like nearby *Mwinilunga,* people cook with charcoal. Making charcoal is a common way for families to make money to buy supplies and pay for their children's school fees. A study conducted in Zambia's Northwestern Province in 2013 confirmed that poverty, lack of employment and limited livelihood options are major factors behind charcoal production [7]. Since charcoal burning (the process of making charcoal) is illegal, charcoal-makers wheel their wares to the market in the middle of the night. If a vehicle is spotted heading down the dirt road, the charcoal is stashed in the bushes to avoid detection.

A comparison of satellite maps from 2012 to 2017 reveals new swatches where trees have been cleared near Machamba village (see image 13,14). Some of these swatches of missing trees were likely cleared while I live in Machamba.

Image 13 Map data ©2012 Google; Satellite Image, Machamba Village, Northwestern, Zambia 2012

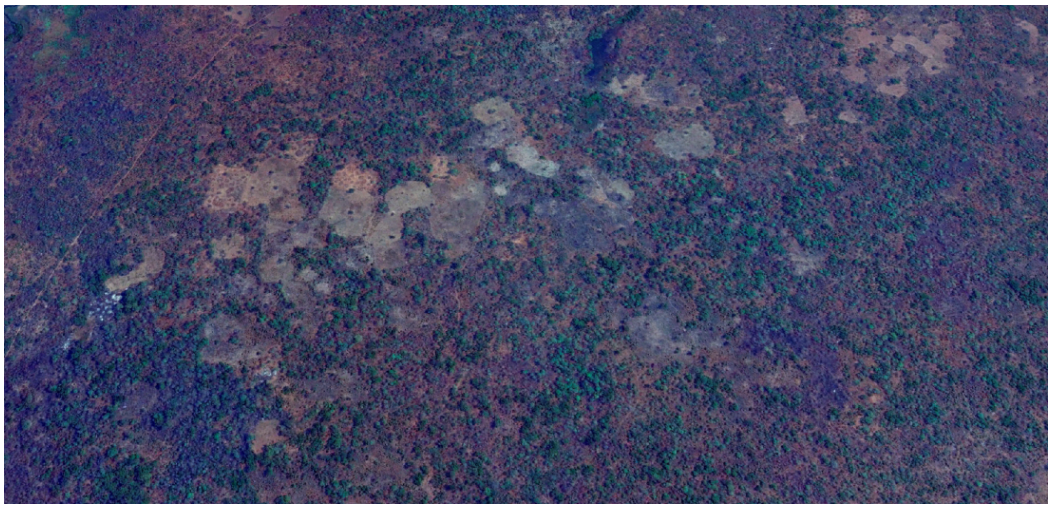

Image 14 Map data ©2012 Google; Satellite Image, Machamba Village, Northwestern, Zambia 2012

According to the Government of the Republic of Zambia, charcoal production is a major driver of deforestation and environmental degradation. Zambia's annual rate of deforestation is 0.33%, a quarter of which of is reportedly due to charcoal production. Charcoal production is driven by urban demand, with a typical household in the capitol city, Lusaka, consuming an estimated 1.3 metric tons of charcoal per year [7].

Proposal

Cricket farming may be able to reduce dependency on the observed food and income sources which have negative environmental impacts. A successful cricket rearing operation could reduce the need for practices like caterpillar harvests and charcoal burning. Breeding crickets for human consumption and income generation requires more than the design of a physical enclosure. Communities need workshops or outreach programs through which they can learn to build, maintain, and profit from cricket farms. This proposal outlines the benefits of cricket farming, and it suggests key partners and strategies for implementing cricket farming in rural Zambia.

Compared to Traditional Livestock

Crickets are a frequently eaten food in Mwinilunga, and unlike raising livestock, families can begin breeding crickets with no startup costs. To start breeding, native crickets can be caught in the wild and added to enclosures. Once cricket farms are well established, small and regular harvest can be made. In lab tests, cassava (the crop grown most commonly in Northwestern Province), was a suitable food for crickets [8].

According to an FAO study, consuming insects has several advantages:

- They have high feed-conversion efficiency (an animal's capacity to convert feed mass into increased body mass, represented as kg of feed per kg of weight gain)(see figure 2).
- They emit relatively few GHGs[3] and relatively little ammonia.
- They require significantly less water than cattle rearing.
- They have few animal welfare issues, although the extent to which insects experience pain is unknown [9].

[3] **GHGs** Greenhouse gases

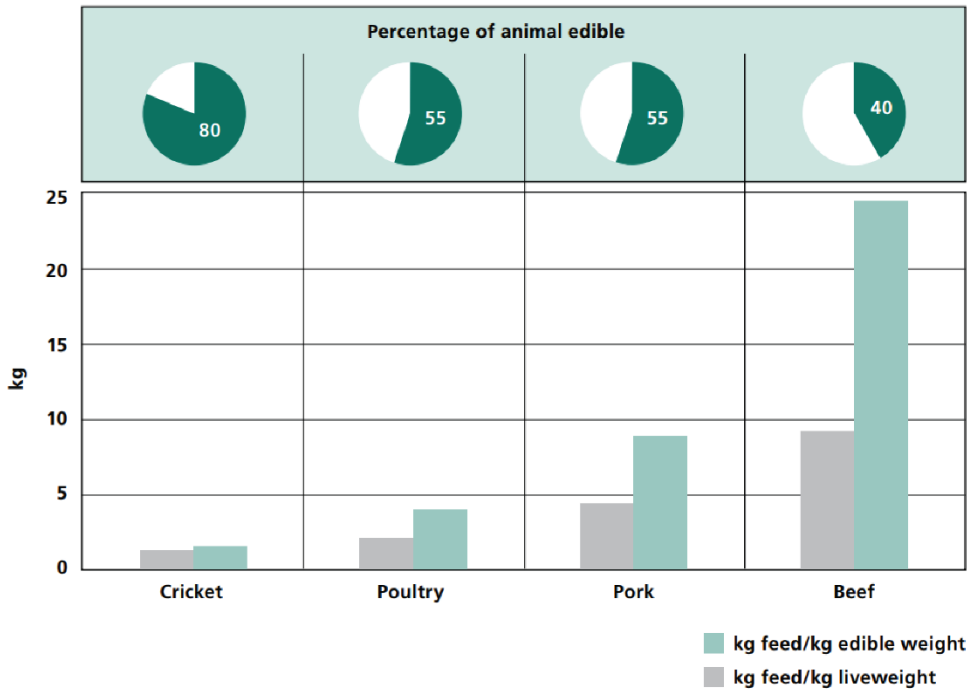

Figure 2 - Efficiencies of production of conventional meat and crickets [10]

Additionally, and more importantly, eating meat, like goat or pork, requires the slaughter of an entire animal worth more than the average person makes in months. In areas without refrigerators, the meat from the entire animal is quickly eaten before it spoils. In my two years in Machamba, a goat was only slaughtered on one occasion, for a wedding. Animals are sometimes the only thing of value that a family can sell or trade. Some families in Machamba do not butcher livestock unless the animal has died of disease or natural causes because the animals are considered too valuable. Obtaining and breeding new livestock (cows, goats, pigs, chickens) requires money.

Generating income through the sale of farmed crickets

Cricket farming is well established in rural parts of Thailand. Conducted studies demonstrate cricket farming has had a notable impact on rural livelihoods in Thailand in terms of household income, social and human capital [11]. It would stand to reason that farmed crickets in Zambia could be sold for similar prices as foraged grub worms and caterpillars that are frequently sold in Mwinilunga markets; making cricket farming a viable option for promoting food and income security. If farmers can sell crickets for the same price as foraged caterpillars and grub worms, they are more likely to abandon the foraging practices.

Implementing Partners

Through my experience working with U.S. funded NGOs in this region, a community outreach program that teaches cricket farming as a source of food and economic development could be an attractive proposal to nonprofits in the health and economic development sectors. In 2018, Zambia received 334 million dollars in foreign assistance funding from DOS[4] and USAID[5] alone. This funding was primarily spent in the Zambian health sector [12]. Despite its status as a lower-middle income country with mineral wealth, Zambia ranks poorly on human development indicators with child malnutrition and its rural poverty levels among the highest in the world. U.S. assistance to Zambia seeks to reduce poverty through the promotion of agriculture-led economic development and food security, through the fight against deforestation and wildlife poaching, and through the expansion and improvement of the quality of health and education opportunities [12].

Proposed Phases of Cricket Farming Outreach

In my previous work experience with Education Development Center (EDC), we developed a successful mobile app with activities used to teach reading in Zambian primary schools. The nationwide launch of the application was conducted in several phases. The success of the mobile application leads me to believe, a nonprofit organization could use a similar approach when implementing a community outreach program. Implementation of a cricket farming outreach program would consists of four main phases: testing, feasibility study, pilot and rollout. Potential steps of each of these phases are outlined in the following lists.

Testing

- Select cooperating partners and establish a secure and sanitary test site.
- Build several variations of cricket enclosures using locally available materials and construction methods.
- Collect local species of edible crickets.
- Test ideal conditions for breeding local crickets in captivity.
- Use results to construct a farm for demonstration purposes.
- Develop tutorials and instructional materials.
- Develop criteria for selecting future feasibility study participants in proximity to the test site.
- Identify interested participants for a feasibility study.
- Analyze and reflect on outcomes from the testing phase.

[4] **DOS** U.S. Department of State
[5] **USAID** United State Agency for International Development

Feasibility Study

- Adapt or modify the feasibility study plans based on reflections from the testing phase.
- Use surveys and the selection criteria to select participants.
- Use test farms and training materials to conduct a training workshop with interested participants.
- Get feedback from new participants after initial training.
- Visit each participant to help establish their own cricket farms.
- Conduct a follow-up visit to each cricket farm at least once every two weeks.
- With each participant, conduct counts of cricket populations and any harvests.
- Survey participants and determine which factors contributed to success or failure of farms.
- Refine training materials.
- Refine participant selection criteria.
- Be vigilant of any unintended consequences or environmental impacts that may occur at a larger scale (are local resources being overused?).
- Analyze and reflect on the outcomes feasibility study.

Pilot Study and Rollout

- Adapt or modify the pilot study plans base on reflections from the feasibility study.
- Use participant selection criteria to identify interested participants near successful feasibility study farms.
- Of the participants who meet the selection criteria, randomly select a control group (who receives no training) treatment group (those who receive cricket farm training).
- Use surveys to establish a baseline to gauge community health and income.
- Use successful feasibility study participants and farms to train the treatment group.
- Establish feasibility study participants as mentors for the treatment group.
- Visit each participant to help establish cricket farms.
- Conduct monitoring visits every two weeks.
- At 3,6,9, and 12 months, conduct participant surveys and counts of cricket populations.
- Analyze results and reflect.
- Use reflections to help develop strategies for expanding cricket rearing trainings in other Zambian Provinces.

Considerations

The following suggestions should be considered during testing, feasibility, and pilot study phases.

Building Materials
To make cricket farms accessible to the most vulnerable populations, cricket enclosures need to be made or sourced from locally available materials. Some materials to consider are mud bricks, plastic bottles, grass thatch and egg cartons.

Demonstration
Showing that cricket farming works before participants try to build and maintain their own farms is key to building interest in the project. If potential farmers are fed a meal from a cricket farm and told how often they could expect to harvest crickets, they would be more interested in trying it for themselves.

Tutorials
Videos need to be filmed in a way that communicates without words. This is key for rollout to multiple languages. Over 72 languages are spoken in Zambia alone. This visual method of creating tutorials was successful when I worked with EDC. We were able to use the same videos to train teachers and principals in five different languages across Zambia.

Cricket Maintenance
Livestock in Machamba usually roam free without being pinned or caged, and animals are expected to forage for themselves. Training workshops and material need to convey that routine maintenance is critical to the success of a cricket rearing operation. Training should help participants to establish routines and habits that lead to successful operations. Training should demonstrate what may happen when maintenance schedules are not followed.

Security
Theft of food and livestock is a common issue. Cricket farms would need to be near people's houses to prevent theft. Once prompted, each participant will probably know which measures are necessary to prevent theft in their area.

Limitations
This cricket farming approach will not eliminate deforestation in the Northwestern province. There is not a single solution to a loss of biodiversity. For example, this proposal does not address a foreign demand for timber, or explore changes to policy, or increase the operating capacity of the Ministries of Forestry and Agriculture.

Additionally, people will still enjoy the taste of caterpillars, so they may still forage for them. However, there is one species of caterpillar that is harvested by digging up buried cocoons that can be harvested without cutting down trees. Or maybe a new tool can be designed for collecting other species of caterpillars without cutting down trees.

Conclusion

The design of a physical product in this case study was only a minor part of the entire scope of work required to increase food security and reduce unsustainable practices. The construction of cricket enclosures would not benefit this community without a significant amount of testing, training and community engagement. Therefore, I focused on planning a community outreach program that teaches cricket farming. This strategy was adapted from multi-phase preparations I used to develop and rollout ICT-mediated trainings across Zambia while working with EDC.

The key takeaway from Case Study 1 that has contributed to my design philosophy is that to truly understand and create for a user group, it helps to have similar lived experiences. My suggestions for improving food security in Zambia would fail to consider the complex needs of Zambians if I hadn't lived in Machamba. The cricket farming idea came from reflecting on experiences that I had while living in rural Zambia, and from work conducted while with Peace Corps and EDC

I also realized that while it is tempting to solve what seem like obvious problems in a community across the world, those problems become more nuanced, as you are more immersed in a community. For these reasons, the cricket farming concept would be hard to test without being in Zambia.

This realization led me to pursue other projects that could be tested with local communities. The ICT-mediated trainings in Zambia were successful because we could quickly test and improve our ideas by getting feedback from the product users (teachers and students). To test the resilience of my research system and creative-reflective process, I wanted to be able to quickly test and iterate ideas. For those reasons, Case Study 2 explores a problem occurring in North America, and more specifically Edmonton, Alberta.

Case Study 2 - Mobile App for Replacing Grass Turf Lawns

Case Study 2 was an opportunity to explore the intersection between agriculture and design. This case study explores opportunities for minimizing habitat destruction caused by grass turf lawns. It was also a way to continue exploring and applying the research system used in Case Study 1. Reflections from Case Study 1 led me to shift the focus from secondary research used to justify exploring a topic, to conveying outcomes from primary research. Case Study 2 focuses on outcomes of an *Edible Plantings Trial and Feasibility Study* that I conducted with the City of Edmonton. Then it ends with how findings of the feasibility study led to exploring concepts for a mobile app named *Cultivate*. *Cultivate,* is the face of a social enterprise that supports peer-to-peer (P2P) yard services designed to disrupt norms surrounding grass turf (lawns) in North America.

Background

Ask a 5-year-old child to draw a house, and they will almost certainly draw a grass lawn in front of it. A NASA study found that grass turf is the largest irrigated crop in the United States. Despite differences in climate and soil conditions, most of the grasses used in U.S. lawns are not native to the area and thus in most parts of the country, lawns require large amounts of added fertilizer and water to survive [13]. Although this study focuses on the U.S., the same factors apply in Canada. Consider the amount of time and resources the average North American devotes to maintaining a yard that is mostly ornamental. In Canada, the landscaping and lawn care industry is nearly an $8 billion industry [14].

Feasibility Study

In Edmonton, a Land Vegetation Inventory conducted in 2015 showed the city maintained 5,757 hectares of grass turf [15]. Recognizing the potential for underutilized grass turf in Edmonton, members from City Operations were interested in testing a way of converting portions of grass maintained by Horticulture Southwest into edible or pollinator friendly plantings (see image 15). In 2018, I helped conduct an *Edible Plantings Trial and Feasibility Study (appendix 2)* with the city of Edmonton. The study was conducted to get an idea of how edible, native, or pollinator friendly plantings could be applied and maintained at a similar speed and cost of grass turf lawns.

Image 15 Hanks, Daniel; "Hydroseeding A Garden, Braithwaite Park, Edmonton, Alberta 2018

Major Takeaways from Feasibility Study

- Hydroseeding[6] is an effective method for planting some edible and pollinator friendly plants.
- When planting seeds with a hydroseeding system, smaller seeds that get planted at shallow depths worked best.
- A rainy summer, and the hydroseeding application allowed seeds to sprout and grow into food producing plants with only one early watering.
- The paper mulch from hydroseeding prevented most weeds from growing in planted areas.
- Since there was no signage, only community members who approached feasibility study workers were aware of the effort.
- With no signage to engage the local community, and no plan for 2019, the area that was planted in 2018 was overgrown with tall grass in 2019.

[6] **Hydroseeding** (or hydraulic mulch seeding, hydro-mulching, hydraseeding) is a planting process that uses a slurry of seed and mulch. It is often used as an erosion control technique on construction sites, as an alternative to the traditional process of broadcasting or sowing dry seed. [19]

Outcomes

Public spaces make up only a part of the maintained grass turf in cities; the rest is found on private lawns, which account for a vast amount of resource use and waste production. The results of the *Edible Planting Trial and Feasibility Study* led me to explore for options that could be applied to convert private lawns into more sustainable yards. The solution – ***Cultivate*** - links knowledgeable gardeners with homeowners who want all of the benefits of a sustainable garden without the hassle of maintaining one (see image 16).

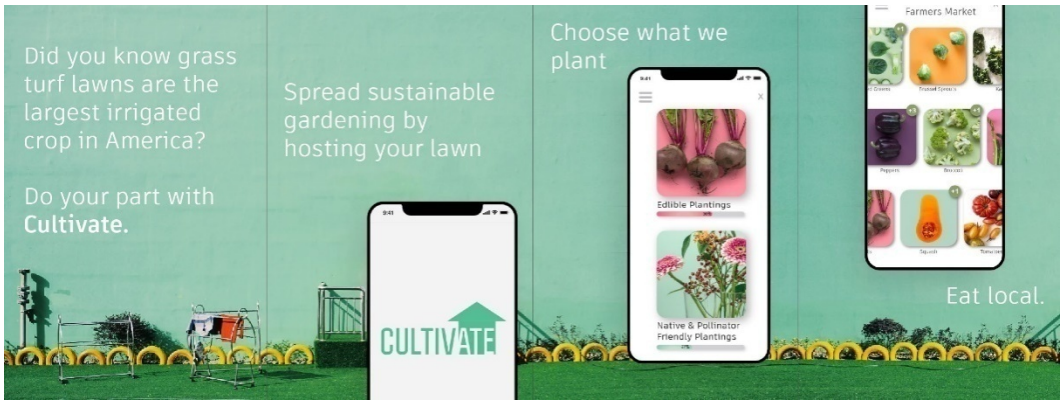

Image 16 Hanks, Daniel; "Cultivate Playstore Banners" 2019

Cultivate

Cultivate is a mobile app and social business for P2P yard services. It pairs local landscaping enthusiasts with yard owners who want to convert their lawns into sustainable gardens. Cultivate is designed to simplify the installation and maintenance of native, edible, and pollinator-friendly plantings with the aim of replacing grass turf lawns.

If this P2P urban gardening app succeeds at disrupting norms, it could encourage the conversion of lawns into less resource intensive gardens with native and pollinator-friendly plantings. The benefits of lawn conversion include the reduction of wasted resources used on lawn care and maintenance, the promotion of native flora and fauna, the elimination of monocultures, and production of fresh locally grown produce.

Potential Value Propositions

The following are key value propositions that can be explored to appeal to potential *Cultivate* customers.

- With *Cultivate,* no gardening experience is needed. Cultivate is a turnkey solution where the customer selects the plants they want via the app and C*ultivate* takes care of the rest.
- Once a week, a *Cultivator* visits to check on your garden, harvest, clean and drop off fresh vegetables.
- Customers don't have to replace their entire lawn to benefit from Cultivate*.*
- Customers get fresh vegetables and fresh flowers at a similar cost without having to go to a grocery store.
- Cultivate creates an opportunity in your own yard for the family to learn about growing and making healthy food choices.

Future Explorations

For further development of the social business and app concept, the following topics ought to be explored:

- How does one change the perception that a non-turf yard makes a house less valuable?
- How does one leverage builders in new housing developments to establish entire neighborhoods managed by Cultivate*?*
- How does one prevent and address negative feedback from neighbors?
- Would hydroseeding be a feasible method for planting private gardens?
- How does one account for short growing seasons in Edmonton?
- What business model would make Cultivate a competitive alternative to grass turf?
- How could the impact of converting grass turf to gardens be measured?
- How would *Cultivate* Yards be able to verify that the garden is planted and maintained by users of the Cultivate app?
- Can Cultivate facilitate operations on city owned land?

Conclusion

Findings from Case Study 1 led me to explore concepts that could be tested locally. In Case Study 2, I tested the feasibility of using hydroseeding as a planting technique for replacing grass turf in Edmonton, Alberta. The promising outcome of the *Edible Plantings Trial and Feasibility Study* with the City of Edmonton led me to explore opportunities for linking residential homeowners with the resources and information about replacing grass turf lawns.

Case Study 2 was an exploration of unconscious consumption, and it was a chance to examine norms surrounding an issue that many people are not aware of. My inventory revealed the scale and scope of work involved in executing a service like Cultivate. Listing the potential value propositions and further explorations was a way of quantifying the human resources and capitol needed to create the actual business and mobile app. Starting a business like Cultivate would require a team of professionals with a range of experience including: environmental science, business, and UX/UI. I created renderings of the cultivate app to convey the intent of Cultivate as a first step toward gathering human resources and capitol to further realize such a business.

Case Study 2 provided an opportunity to explore a local issue. This emerged from the findings of Case Study 1 which highlighted the need to be within a community to understand and conduct multiple iterations of concepts to develop products which meet the needs of a specific user group. Similarly, it is beneficial to collaborate with an established local organization. The existing contacts and resources of City of Edmonton's Horticulture Southwest contributed to the success of the *Edible Plantings Trial and Feasibility Study*.

To further test the strength and adaptability of my design approach for improving the social and environmental commons, I was interested in doing more physical prototyping and manufacturing for an existing organization. This interest in physical prototyping is for social and environmental commons is detailed in Case Study 3.

Case Study 3 - Co-creation for Recycling

This case study draws on literature reviews and personal experiences while examining opportunities for income generation and waste diversion in various developing countries by creating a means of manufacturing roof tiles from discarded plastic. The aim of this case study was to contribute to the work of a non-profit, Precious Plastic (PP), that hosts the co-creation and open design of products, machines and systems for plastic recycling.

Case Study 3 builds on lessons learned from the previous studies. In this study, I decided to contribute to an established organization because they have a proven business model. Unlike Case Studies 1 and 2, PP has existing products, value propositions, and key partners, which ensured that the contributions I make can reach and be tested by users all around the world. Additionally, the Precious Plastic platform allows me to make and collaborate with a large community of creators while building and testing ideas locally.

Background

Image 17 Precious Plastic; Plastic Recycling Machines

Precious Plastic

Precious Plastic is a non-profit organization based in the Netherlands, that links communities with the common goal of increasing the amount of plastic recycled around the world. The open-source machinery, educational material, and tutorials developed by the PP community are ideal for remote locations without access to recycling centers (see image 17). Communities have used Precious Plastic machinery to transform plastic waste into products which are used and sold both locally and online.

Scope and Scale of Precious Plastic Workspaces

The Precious Plastic community consists of hobbyists, university students, co-ops, non-profits, businesses, designers, engineers, machinists, and social activists all interested in increasing plastic recycling. The Precious Plastic community is able to connect through the Precious Plastic platform and forum. Each flag icon on this world map (see image 18) denotes a Precious Plastic workspace, and each wrench icon denotes people who are interested in helping with Precious Plastic activities.

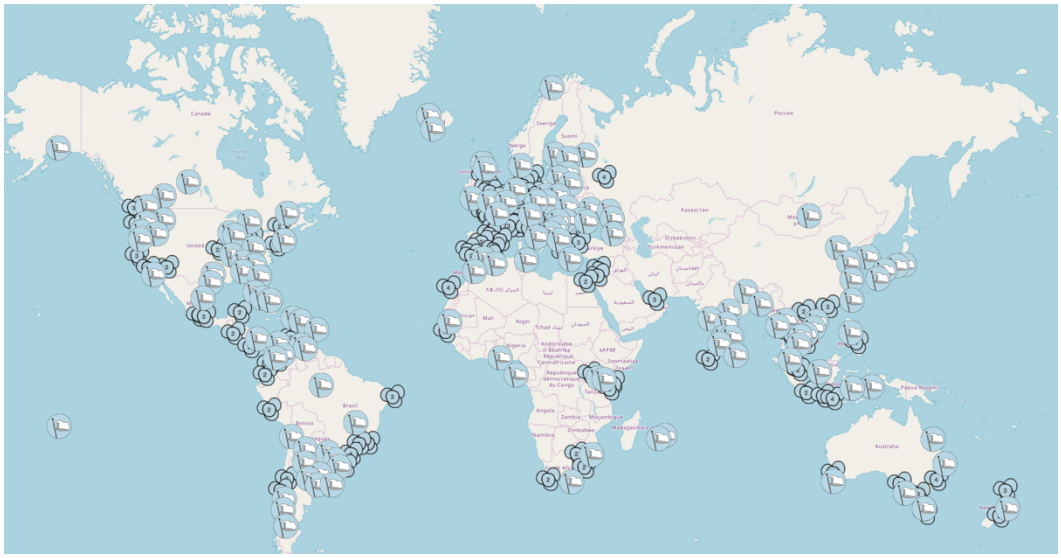

Image 18 Precious Plastic; Precious Plastic Community

Precious Plastic Machines are designed to be constructed from common materials and processes to encourage local construction with supplied shop drawings and tutorials. Improvements for machines and additional molds are shared by community members through the forum. Pre-built machinery can also be purchased from local manufacturers through the platform. The adaptability of Precious Plastic designs and the use of commonly available materials contribute to the worldwide spread of PP workspaces.

Products for Sub-Saharan Africa

Many developing nations have no government funded recycling infrastructure; private companies collect unsorted household rubbish and truck it to enormous dumps to be sorted. In these situations, transporting plastic waste from smaller towns to the recycling centers becomes unfeasible, and thus plastic ends up littering the streets or ends up being burned in large fires [16]. In Zambia, there was a pile of trash constantly burning near large markets. The Precious Plastic model is well suited for rural towns that do not necessarily have access to the recycling facilities available in larger centers.

Since the aim of Case Study 3 was to gain exposure to designing and prototyping products that would fit within an existing business model, my goal was to create designs which could be tested and used by communities with established Precious Plastic recycling centers. While there are no operational workspaces in Zambia, I wanted to draw on my experience from living there to create products for existing PP communities in neighbouring countries with similar needs. Rural areas of Tanzania, Kenya, and South Africa have several operational workspaces.

Design Criteria

I began exploring opportunities for new products that would be beneficial in Sub-Saharan Africa by creating an inventory of existing Precious Plastic products to examine common features, and construction techniques. Exploring existing and potential products helped me to establish design criteria for creating molds.

Compression Machines

A frequently used method for creating new products with PP machinery is through building compression molds from laser cut parts. This method allows other people in the community to quickly assemble a mold with relatively little machining (in comparison to milled molds). It also allows molds to be flat-packed and shipped, then assembled with some welding on site.

Through this study, I hoped to devise new manufacturing processes by developing, testing, and sharing the plans for constructing a mold which could be used in the Precious Plastic compression machine (see image 19). With the plastic compression machine, plastic is heated inside an oven and slowly pressed into a mold with a carjack. This method is well suited for making large and more solid objects, like the roof tiles. The process is generally slower than the other Precious Plastic machines, but it allows for bigger objects to be crafted. This machine can also be used to create new raw material, like sheets of plastic that can be further worked into new products.

Image 19 Precious Plastic; Compression Machine

Outcomes

Roof Tiles for Recycled Plastic

Metal roofs are highly desirable across Zambia, but they are often too expensive to afford. People of the Lunda tribe who live in Northwestern, use grass to construct roofs that stay incredibly dry. However, with heavy rains and large termite populations, grass roofs deteriorate and need to be rebuilt more often than metal roofs. They are also vulnerable to grass fires that are common in the dry season. In rural areas like Zambia, using methods and machinery developed by the Precious Plastics community could help reduce plastic waste while providing locally manufactured alternatives to grass and metal roofs.

This need for an alternative for metal and grass roofs in Sub-Saharan Africa led me to explore creating plastic roof tiles (See image 20) that make use of and contribute to the Precious Plastic community. After coming up with a concept for a roof tile, I created a mold that can be used to fabricate the tile (See image 21).

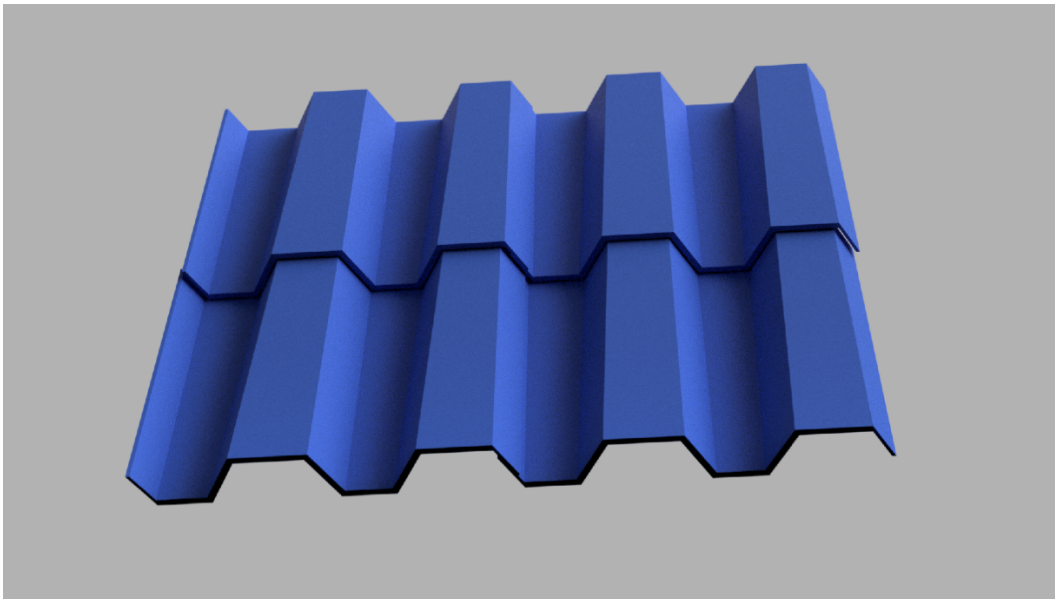

Image 20 Hanks, Daniel; 4 Plastic Roof Tiles, 2019

Mold Construction

This mold is created by welding together parts which are laser cut from sheet metal. Molds that are made from sheet metal are typically faster and less expensive to produce than molds that are machined from solid stock. Anyone interested in building the roof tile mold can download the template to have the parts cut from steel with a laser or waterjet cutter.

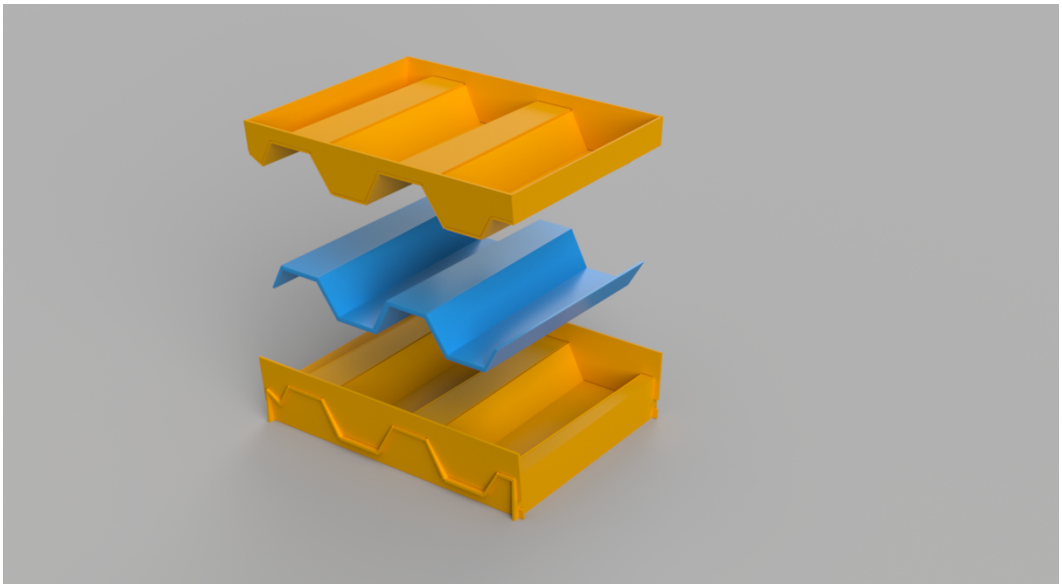

Image 21 Hanks, Daniel; 4 Plastic Roof Tiles, 2019

The following are some considerations made when designing the mold and roof tile:

- The mold needs to fit into the Precious Plastic compression machine.
- The mold should be easily assembled once all parts are cut.
- The tile needs to be thick enough to be durable.
- The tile can't be too thick: material is wasted, and the tiles become too heavy for the roof frame to support.
- The roof tile should be able to tessellate in both the vertical and horizontal directions.
- Secondary tiles can be created for the top and trim of the roof.

Sharing Designs with Precious Plastic Community

By sharing design drawings, CAD files, images, and videos, contributors can share designs that are useful to members in the community. Sharing the designs also allows other members to contribute to the work. Sharing the current design drawings, CAD files, and images of outcomes from the roof tile mold with the PP community will lead to further development and use of the concept by the community. If other members are interested in using a compression mold to manufacture roof tiles, they can download

and modify models to suit their needs. If improvements are made, those improvements are often shared with the community.

Future explorations

Refining Roof Tile Concepts
Several more prototypes can be designed and tested to improve the overall properties of roof tiles and mold. Data can also be collected to determine costs and durability of recycled plastic roof tiles to make locally manufactured roof tiles competitive with other roofs on the market. If there is a significant demand for plastic roofs, Precious Plastic machinery can be adapted to create a machine that can manufacture tiles faster and more efficiently.

Establishing a Precious Plastic Workspace in Edmonton
The Precious Plastic community may be a way to help lessen the plastic waste problem here in Edmonton. Plastic waste is a problem that affects almost every populated city in the world whether it is in a rural town in Zambia or here in the City of Edmonton. Just because we don't see the problem right in front of us doesn't mean it isn't happening. Part of the reason we produce so much waste, is because we aren't confronted with our garbage. Everything is efficiently removed from our homes. But go to the Edmonton waste management plant and one sees a different story. The Edmonton Waste Management Facility does not recycle any plastic, it only processes and sells profitable plastics to recyclers. As a result of this, there are many discarded plastics in Edmonton that could be recycled but are not. The overabundance of wasted materials, particularly plastic, is alarming.

Hosting Classes in a Makerspace
There is an emerging Precious Plastic community in Edmonton that is interested in constructing and operating a plastic recycling workspace. This workspace could host classes to a variety of interested participants from elementary school students learning about recycling to retirees who are looking for a new hobby. Depending on their age and skill, participants could experiment with precious plastic machinery through using existing molds or the creation of new molds. The Precious Plastic community may also provide an opportunity for industrial design students to make use of free materials while participating in co-designing and exploring principles of injection and compression molding that also may help address the plastic waste problem.

Conclusion

The key finding from this study is not only important to my personal growth but also provides opportunities for other students too. Through this case study, I discovered that organizations like Precious Plastic promote sustainability while providing an opportunity to develop essential design skills. Platforms similar to PP, are good for finding short-term projects where students like myself can collaborate with other creators around the world to make products with real-world applications. The broader implication of this research suggests that using plastic recycling machinery to create artifacts can eventually develop into fully realized products. In this case, products designed with the PP business model can potentially divert waste from burn-pits, landfills, and waterways.

Unlike in Case Studies 1 and 2, Precious Plastic is an existing organization which promotes sustainability worldwide. Working through an established organization allowed me to contribute to worldwide projects with knowledge relevant to my previous work experience while prototyping and testing ideas locally. Future research and explorations related to Precious Plastics should focus on expanding my personal knowledge and the knowledge of other students in areas of plastic recycling and manufacturing. This can be achieved through establishing a local Precious Plastic workspace.

Thesis Exhibition

Each piece presented in the *Consumplation* exhibition is a work in progress. The goal of displaying these varied explorations is to encourage visitors to think of industrial design as more than an approach to designing products that are manufactured through techniques of mass production. The live and very real-world projects featured in C*onsumplation* are critically important to understanding the diverse obstacles that people face day-to-day. Each piece demonstrates unique value propositions, and key partners used to encourage sustainability.

The *Consumplation* exhibition begins by illustrating my creative-reflective design approach to prototyping through Bashiwa Bar Stool. The collection of seemingly artifacts which led to the creation of a more functional object, Bashiwa Bar Stool, were created to expand my knowledge of 3D modeling, 3D printing, CNC machining, and wood turning. This furniture evolved from reflections on those artifacts and processes. The creation of the Bashiwa Bar Stool also led explorations of products and services that aim to reduce the destruction of our environment.

The *Consumplation* gallery exhibition challenges a different aspect of my design approach. The demonstration of prototypes to an audience is an important part of implementing an effective idea. Speaking to gallery visitors about prototypes of the *Cultivate* app and the roof tile mold, will allow me to further refine the concepts. Discussion about these works will lead to the creation of new products and services which improve the human condition without promoting the destruction of our environment.


chef bombay


CRICKET
FARMING


PLASTIC
ROOF TILES

Conclusion

The thesis support document and gallery exhibition are tools used to reflect upon experiences that have shaped my personal design philosophy. *Consumplation* is about being mindful of the impacts of the products we create. This study has helped me understand and better articulate my own approach to design and, in turn, to create a more efficient system for me and others to consider using to balance the wellbeing of individuals, society, and the natural environment.

The first key finding came through my own practice related research. I discovered that more purposeful products evolve from learning manufacturing processes. The unstructured creation of artifacts facilitated reflections and the development of skills which later contributed to the creation of more realized products.

The second key finding in this study was that students can learn essential design skills and concepts of sustainability through organizations such a Precious Plastics. Through similar open design online platforms, students can test ideas locally while collaborating with creators around the world to build real-world products. Contributing to an organization like PP allows students to research, test, and implement new ideas which have real impacts on environmental sustainability.

Key findings 1 and 2 lead me to believe that students can potentially increase recycling around the world if they learn to use Precious Plastic machinery. In my case, learning plastic recycling processes through the creation of artifacts eventually lead to the development of a needed product in rural areas of Sub-Saharan Africa. Developing a new product from old and discarded products helped me to focus on creating products with utility, instead of a trinket that would later be thrown away. Using plastic recycling equipment to prototype helped me to consider the types of products that are need most. The discovery of characteristics which make organizations like Precious Plastic ideal for student projects that encourage sustainability was facilitated by case studies 1, 2, and 3.

In Case Study 1, I learned that sharing lived experiences with a community helps to understand the needs of a user group. Describing my experiences in Zambia contributed to ideation of products and services which could address a complex problem in Northwestern Province. However, through this study, I also realized that continuous testing and refinement of a product requires continued access to or immersion in a community.

In Case Study 2, I learned that working for local organizations with established research and resources allowed me to quickly create, explore and test ideas. Conducting a feasibility study with the City of Edmonton was faster than it would have been on my own. The learnings from case studies 1 and 2prompted a search for other established organizations that fit my personal design philosophy.

Finally, in case study 3,I learned that open design platforms provide opportunities for students to learn essential design skills while addressing global needs. Organizations like Precious Plastics connect creator communities to solve global issues while allowing local prototyping and testing.

This study was a way of discovering opportunities for creating and implementing real products and services which can have a positive impact on the environment.
In summary, the case studies and philosophy explored in *Consumplation* provides opportunities for future designers, creators, and me to develop design skills and practices. Each of the featured case studies contains a proposal which can be further developed. Exploring these proposals presents opportunities for students to learn new processes like 3D modeling, the construction of compression molds and the development of business models.

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Appendices

Understanding 3-axis CNC Milling Processes and Constraints

Edible Plantings Trial and Feasibility Study

DESIGNING PRODUCTS FOR MANUFACTURING:

UNDERSTANDING 3-AXIS CNC MILLING PROCESSES AND CONSTRAINTS

The focus of this independent study has been exploring and refining work-flows in AutoDesk Fusion 360 modeling and CAM environments.

These concepts were explored while prototyping the featured wood stool.

DESIGNING PRODUCTS FOR MANUFACTURING:

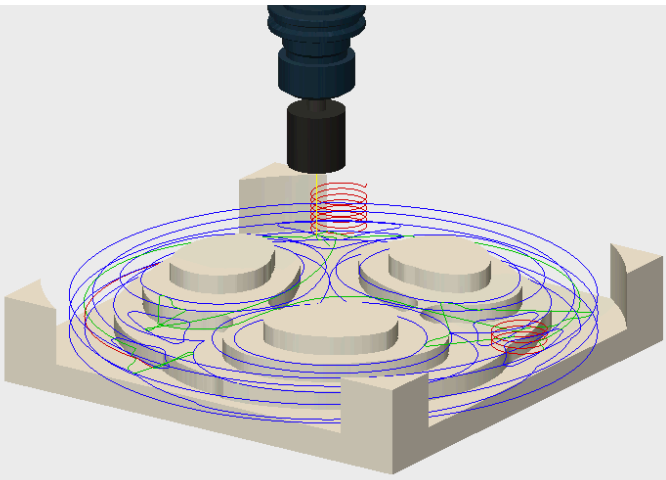
INITIAL CONCEPT AND PROTOTYPES

The initial concept was a CNC milled seat with three mortises for lathed dowel legs. To add stability to the stool, the legs were angled out at 80 degrees

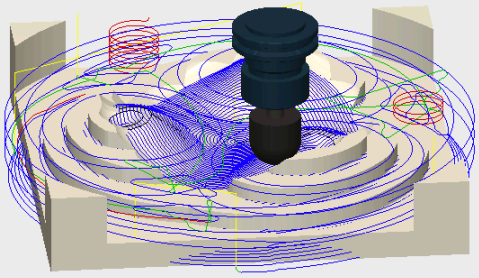
The initial stool featured a flat seat with a contoured surface underneath. The contoured surface of the seat component was designed to be milled from a solid block of wood. The milling process included three operations and two tool changes.

DESIGNING PRODUCTS FOR MANUFACTURING:

MILLING OPERATIONS



The first milling operation was a roughing pass to remove excess material.



The second milling operation was a surfacing pass to that defined the contours of the seat component.

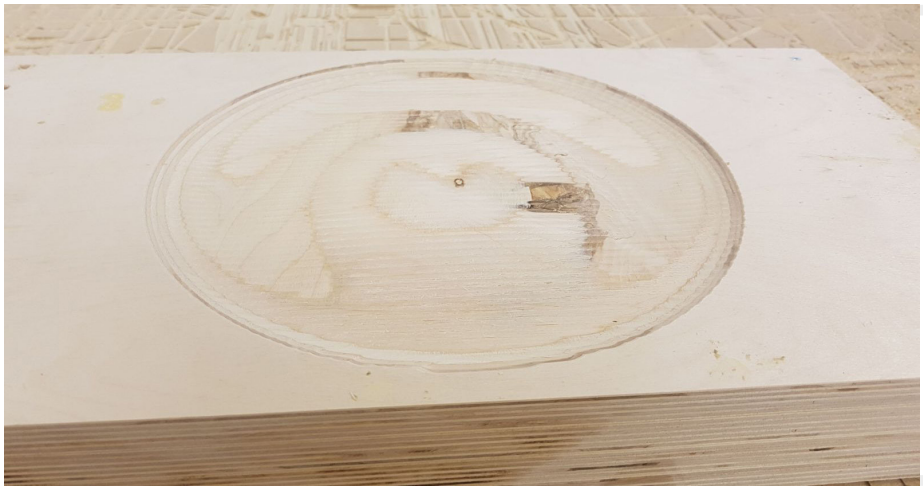
The final milling operation was a contour cut along the outside edge of the component. To test the scale of the seat and the milling operations, the piece was first milled out of foam.

DESIGNING PRODUCTS FOR MANUFACTURING:

REFINING CONCEPT AND MILLING PROCESS

After the foam sketch model, the top of the seat was altered to include a concave surface.

Then, a second sketch model was milled from plywood.



Adding a concave to the top of the seat added complexity to the milling operations. The wood stock now had to be milled on two faces. The concave surface of the seat was milled first.

After the top surface of the component was milled, the stock was flipped over to mill the underside of the seat component.

DESIGNING PRODUCTS FOR MANUFACTURING:

REFINING CONCEPT AND MILLING PROCESS

After the seat component was milled, mortises were drilled at an angle using the drill press.

The legs were dry fitted to ensure they matched the contour of the seat component.

Finally, the legs were glued to the seat component, and the stool was finished with wax.

DESIGNING PRODUCTS FOR MANUFACTURING:

FINISHED PROTOTYPE 1

IMPROVING STOOL 1:

INCREASING STABILITY AND REDUCING MACHINE TIME

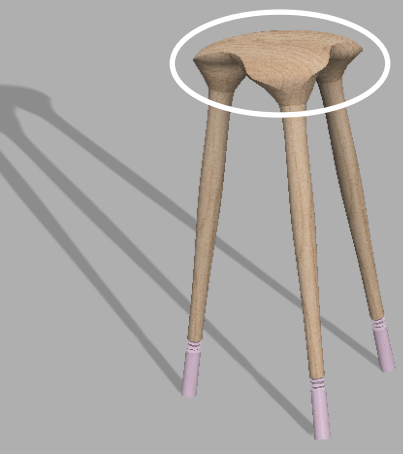
The first wood prototype led to an interest in creating a family of stools with varying heights. It also led to the exploration of techniques that would reduce machine times.

3D printed models of taller versions of the first stool demonstrated that increasing the leg lengths without changing the seat component made the taller stools less stable

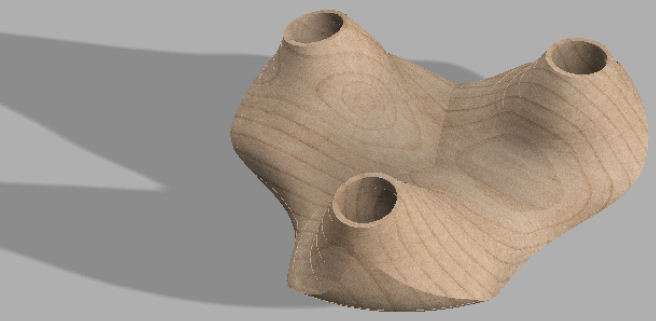
New explorations of the seat components aimed to maintain the aesthetic of a three-legged stool while increasing stability with varying leg lengths. Several 3d prints were made to test stability of new seat components and leg angles.

IMPROVING STOOL 1:

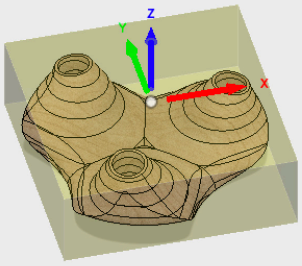
INCREASING STABILITY AND REDUCING MACHINE TIME



A less circular seat component created stools that were more stable at varying leg-lengths.



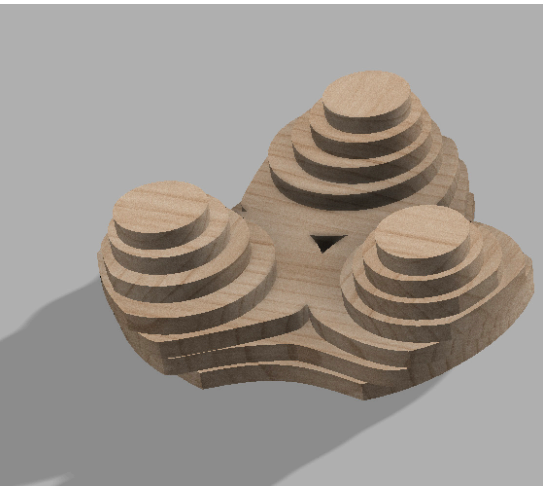
However, the new sculpted seat component required a larger block of wood and more machine time.



Milling this component from a solid block of wood wastes more that 50% of the material. On a 3-axis CNC, milling this component from a solid block also required 4 tool changes.

DESIGNING PRODUCTS FOR MANUFACTURING:

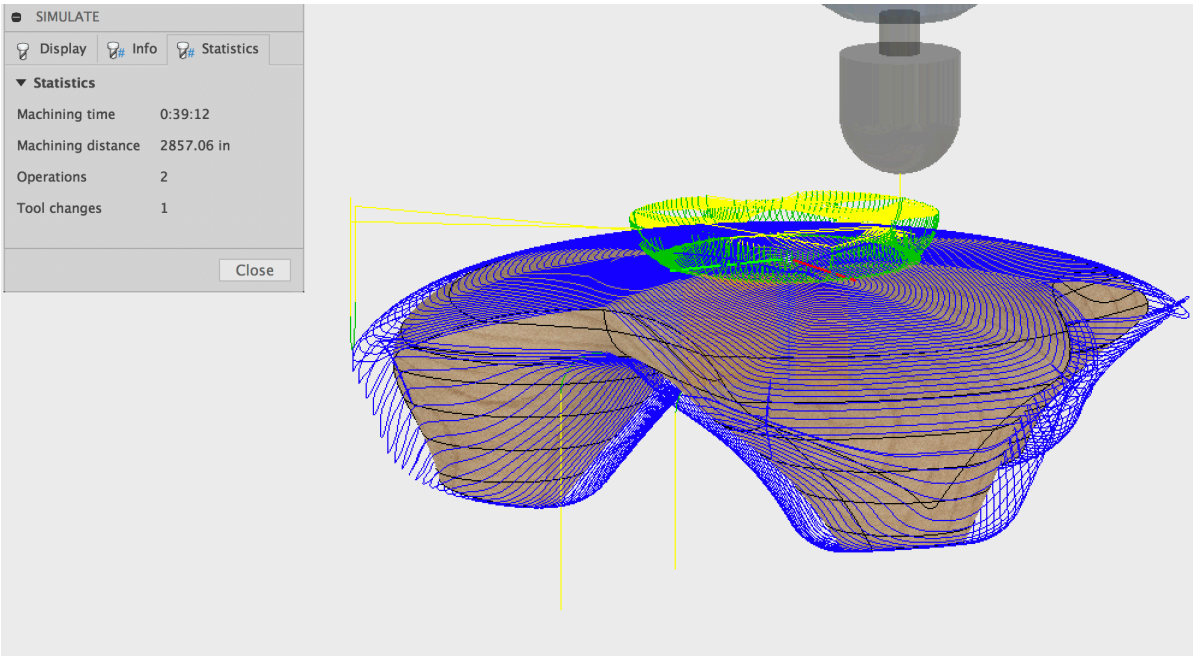
REDUCING CNC MACHINE TIME AND MATERIALS



As an alternative to milling from a solid block of wood, A custom stock was created from stacking and gluing contours that were slightly larger than the final component.

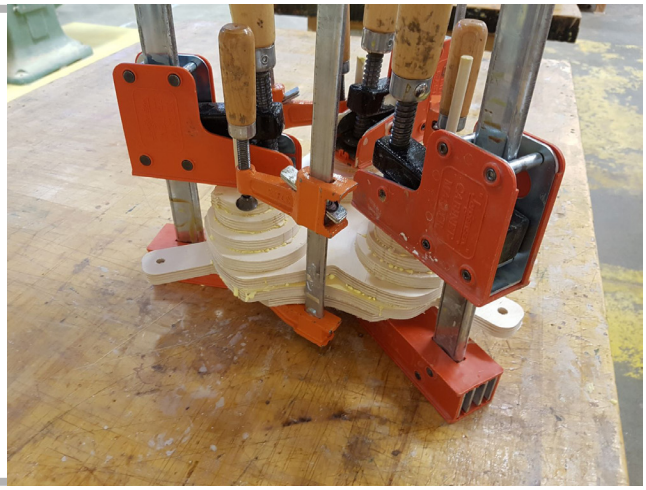
Cutting contours from a sheet of plywood or from plained solid wood eliminates the need for roughing operations. Once the custom stock is glued together, only one surfacing operation is needed for each side of the component.

By eliminating roughing operations, the machine time is reduced by roughly 25%.

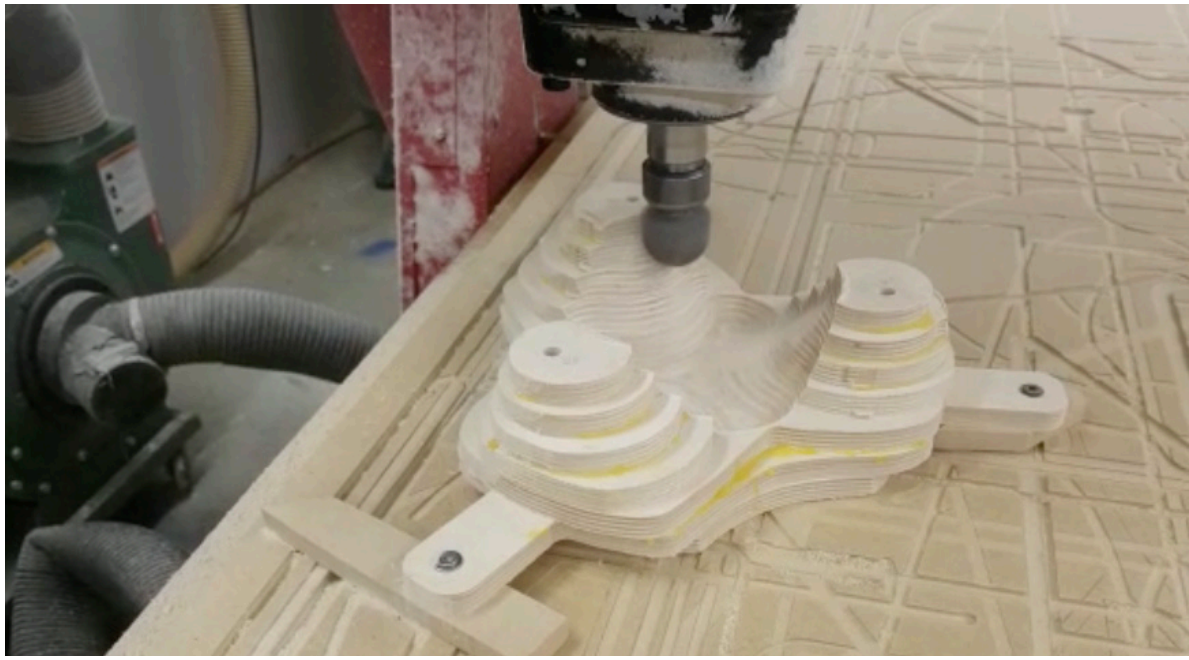


A 1/2 scale prototype of the new seat component was created from 1/2 inch Baltic birch plywood.

The contours were glued together to form a custom stock.

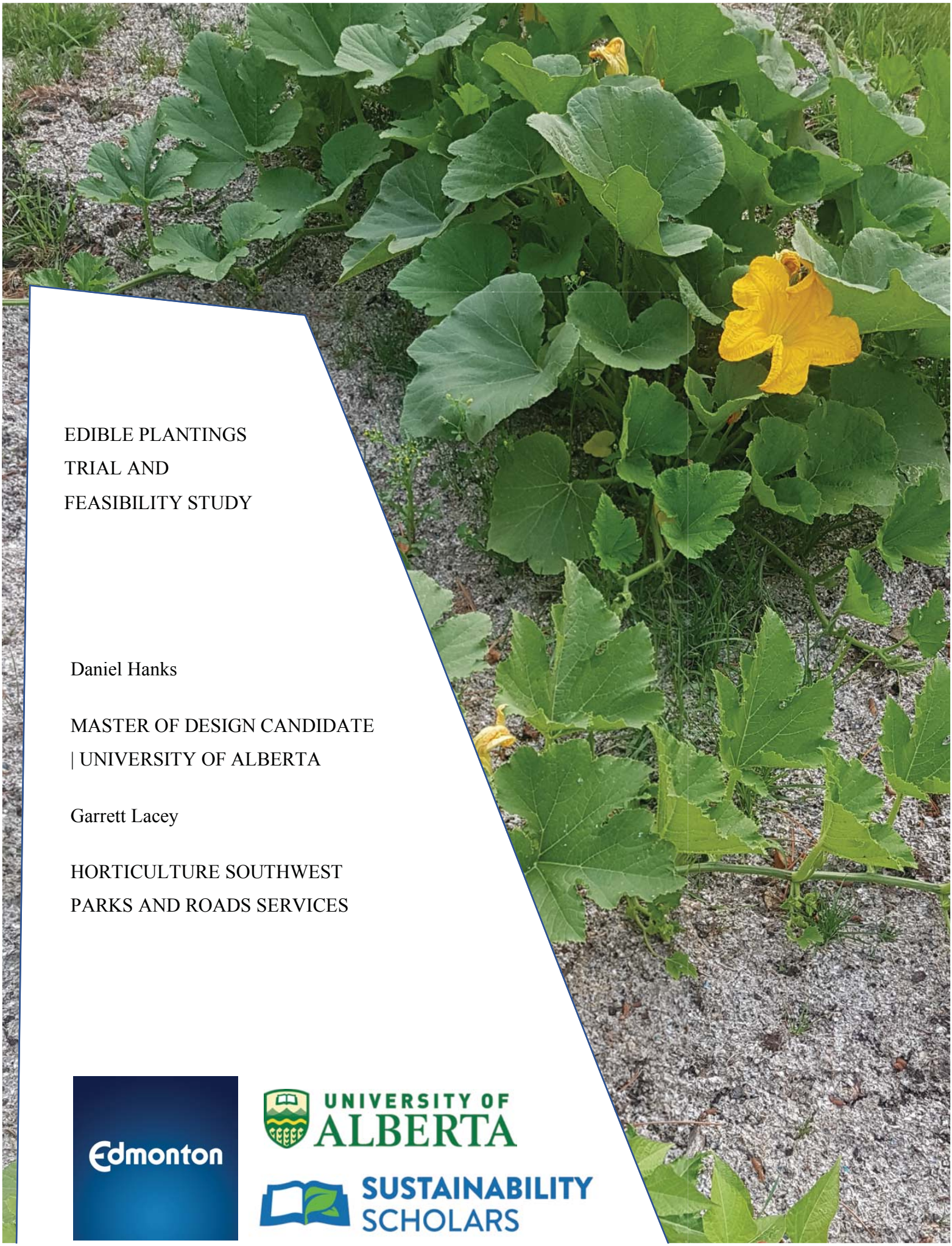


A surface milling operation was performed on each side of the stock.



DESIGNING PRODUCTS FOR MANUFACTURING:

FINISHED SEAT COMPONENT PROTOTYPE 2



EDIBLE PLANTINGS TRIAL AND FEASIBILITY STUDY

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SUSTAINABILITY SCHOLARS

Table of Contents

Executive Summary

A city operated edible and pollinator friendly planting program has the potential to create aesthetically pleasing and engaging parkland that provides education and community building opportunities for residents. Edible planting programs can initiate the formation of community garden associations which create positive effects on food security and urban ecology parkland while simultaneously reducing the workload of City Operations.

This study demonstrates the viability of hydroseeding as a planting method by which Edmonton City Operations can integrate edible and pollinator friendly plantings into its scheduled beautification operations. The study outlines plant and site selection considerations tailored to creating plant communities for stimulating public engagement while requiring little maintenance.

The key findings of this study indicate planting depths as a key determinant in plant performance when planted via hydroseeder. Seeds that germinate at depths of 1” or less were the most successful. Of the seeds tested, Pumpkin, Dill, and Romaine Lettuce performed the best. Seeds that need to be planted at depths greater than 1 inch were the least likely to germinate. Additionally, seeds that need to be planted at greater depths are typically larger. These bigger seeds (eg. bush beans) can break when passing through the hydroseeder, or even affect the operation of the hydroseeding equipment by clogging the nozzle.

Introduction

The Sustainability Scholar Study conducted in collaboration with City of Edmonton Horticulture Southwest establishes a standard practice for expanding edible or pollinator friendly plantings throughout city maintained land. The goal was to determine ideal locations and plant types that encourage community engagement while requiring minimal inputs from City Operations. In some cases, maintenance crews are only able to visit and work at a site once or twice a year. Knowing this, the study's three main objectives included: selecting and testing a **planting method**, creating a **site selection criteria**, and creating a **seed selection criteria**.

The study does not outline, define or quantify the possible benefits of community gardens, urban agriculture, or other edible planting initiatives. The study assumes creating public edible plant communities has the potential to activate residents' interests, encouraging the participation in local food production activities or economies. The focus is purely from an operational standpoint to help inform current and future edible planting programs throughout the city.

Methods

Planting Method

City Operations employee using a hydroseeder to plant vegetable seeds at Braithwaite Park for this study.

Three main methods of planting were considered: planting nursery plants, broadcast seeding, and hydroseeding. Of those options, hydroseeding was the method selected. **Hydroseeding** is a planting process that uses a slurry of seed and mulch. It is often used as an erosion control technique on construction sites, as an alternative to the traditional process of broadcasting or sowing dry seed. The method is typically used to apply grass seed. However, most seed types can be planted with a hydroseeder.

With hydroseeding, relatively large areas can be planted in a short timeframe. Hydroseeding will typically take less time and cost less than planting nursery-raised plants. Estimated materials costs of hydroseeding are $1.30 per square meter. In the case of some large areas, planting by broadcast seeding may be cheaper, but hydroseeding has a much higher germination rate. The fiber mulch used in

hydroseeding accelerates the growing process by maintaining moisture around the seeds. This increased water retention of the fiber mulch was the primary benefit of hydroseeding leading to its selection as the method of planting. This increased water retention allowed city operations staff to reduce the number of site visits needed after planting seeds.

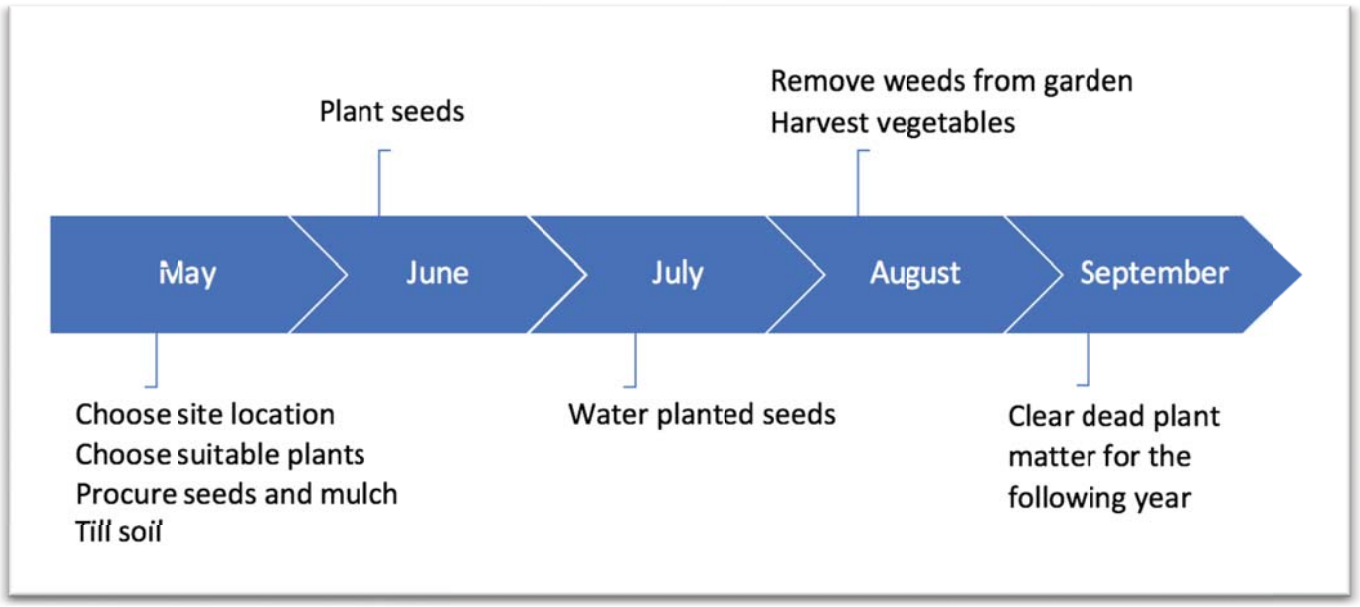
Planting Method Questions

Prior to this study, Edmonton City Operation had never used a hydroseeder to plant edible and pollinator friendly plantings. The study mainly aimed to answer the following questions:

- Do the varying sized seeds of several plant species yield an even distribution of plants if planted via hydroseeding?
- Do seeds germinate if sprayed atop mulched beds via hydroseeding?
- How much time does hydroseeding take per square meter?
- What is the minimum amount of maintenance / labor needed to yield visible results?
- How does this method compare to the cost of other seasonal plantings?

Study Timeline

While the site was visited frequently, the goal was to plant and monitor plant growth and interaction with little intervention. This allowed researchers to determine the minimal amount of site visits needed maintain the site. The study timeline was mainly governed by the outdoor growing season. Below is a graphic depicting a simplified timeline of the study.



Site Selection

Braithwaite Park was selected as the location for the study of hydroseeding as a planting method. The park's proximity to Whyte Ave, made it highly visible to pedestrians on their way to and from the University of Alberta Campus. This gave researchers the opportunity to make informal observations about the interactions of pedestrians with the plantings to determine whether plants would be disturbed or cared for by those who passed by. The image below highlights in yellow the region selected as the location for the trial. The area of the edible planting

Before Braithwaite was selected, three sites were initially considered for this study: Tipton Park, Braithwaite Park, and Charles Simmonds Park. These sites were initially selected for their proximity to parks to Horticulture Operations. Distances less than 2 kilometers from O'Keefes Yard ensured adequate monitoring of plant growth from parks service work crews. Below is a table summarizing site selection considerations that ultimately lead to Braithwaite park being selected as an ideal location for this edible planting study. With further study and development of edible planting programs, City Operations could select sites that are further away.

Initial Site Criteria	Braithwaite Park	Tipton Park	Charles Simmonds
Near High Density Housing	x		x
High Foot Traffic	x		
Water Taps at Site		x	x
Contains Edible Plantings installed by residents	x		
High Visibility	x		
Distance from O'Keefs Yard under 2KM	x	x	x

Seed Selection

The goal was to determine which seeds worked the best with the hydroseeding application method and required little to no ongoing labour or upkeep. A mix of plant types were selected based on their price and perceived factors including: taste, visual interest, hardiness, ability to control pests, and the ability to be identified by passing pedestrians. Below is a list of seed types and quantities planted at Braithwaite Park.

	Pumpkin	Dill (mammoth)	Bush Beans	Scarlette Runner Bean	Kale	Marigold	Chard, Northern Lights	Romain Lettuce
Recommended Planting Depth	1"	1/4" - 1/2"	2"-4"	1"	1/4" - 1/2"	1/4"	1/2" - 1"	1/8"
# of seeds planted (estimated)	250	1000	500	500	750	1600	1750	1500
Grams of seeds planted	70	3	140	140	3	3	28	3

Findings & Outcomes

Large pumpkin plants seen in Braithwaite Park 10 weeks after seeds were planted.

Planting Method Initial Impressions

Hydroseeding in Braithwaite park required the unconventional use of equipment, so there were limited expectations for the outcomes. Overall, planting with the hydroseeder was a success. After ten weeks, the planted bed was filled in with thriving plants. However, there are some areas for improvement. Here are a few pros and cons to hydroseeding.

Pros:

- Quick and even application of seed on areas 50 square meters or larger
- Green Mulch is a great visual marker indicating area has been planted
- Spraying the mulch soaks the soil while applying seed

Cons:

- The hydroseeder gets clogged if larger seeds are in the mix
- Not appropriate for seeds which need to be planted at greater than 1” depths
- City Operations only owns one working hydroseeder

Planting Method Findings / Recommendations

Below are the expanded findings in response to the questions posited at the beginning of the trial:

With exception to bush beans, which clogged the hydroseeder, seeds were evenly distributed regardless of seed type and size. Even distribution of seeds created an intermixed planting. Some plants mixed tightly with pumpkin seemed to be less frequently eaten by rabbits.

Seeds do not germinate when sprayed on top of mulched beds. While a few seeds germinated, the plants did not reach maturation. The mulched bed that received a hydroseeding application also appeared to have a greater number of thistle growth in comparison to nearby mulched beds with no hydroseeding application.

Tilling and soil preparation is the most time-consuming aspect of an edible plantings program. Tilling 70 square meters took about three hours for one person to till the soil. This time could be reduced with larger tilling equipment.

Hydroseeding 70 square meters takes about 55 minutes. The most time-consuming aspect of hydroseeding was setup and breakdown of the equipment. Hydroseeding smaller plots would not reduce application times, as the combined setup (tank flushing/filling) and breakdown (hose rolling, tank flushing) for the hydroseeder is roughly 45 minutes. Once setup was done, it only took about 10 minutes to spray 70 square meters. The size of future edible planting sites could around 150 to 200 square meters with a minimal increase in time of hydroseeding applications.

The minimum amount of maintenance needed to yield visible results is dependent on weather. With weekly rainfall, site visits can be less frequent. After the initial application

of seed, the site was only watered once and weeded once. We decided to only water the site if there was no rain for six days. Thirteen days of rain in July ensured adequate soil moister without additional watering.

Plant earlier: Adjustments to timeline Plant earlier in the spring.

Site Selection Findings / Recommendations

Braithwaite Park was primarily chosen based on proximity to horticulture operations, the park was an acceptable location for this study. However, there are a few observations and recommendations to consider when selecting new sites in the future.

Ongoing construction: The site had ongoing construction less than 20 meters away. The site was used for the storage of construction materials and equipment. The use of the park to store materials detracted from the visual appeal of the garden. The construction deterred peoples' interactions with the edible plantings. In the future, this could be avoided by checking whether locations are near planned city construction.

Few people visiting the park: The site had heavy foot traffic on the sidewalks nearby, but few people spending time in the park. An edible planting program could be a way of attracting people to the park, if a clever use of signage draws the nearby pedestrian's attention to the garden. Signs could encourage people who are passing by to stop and identify several plants.

Signage: If generating community interest and participation is a focus of for future studies, then signs on site will play a key role. Before posting signs, legal issues surrounding community eating plants grown in the public space is a must if signs encourage residents to maintain and eat the garden plantings.

No water faucets: No residents were observed taking care of plants in the garden. The lack of nearby water faucets may have been a barrier to interested residents who wanted to water plants.

When choosing sites: For future edible-planting operations and trials, where community engagement will play a larger role, the following site selection criteria may improve outcomes. See the chart below for an example

Site selection Criteria	*Site A*	*Site B*	*Site C*
Near Residential & High Density Housing			
High Foot Traffic			
Access To water			
Evidence of Interested Residents			
High Visibility			
Established Park Buildings			
Playground Equipment			
Other city activites near by (eg construction)			
Soil quality			
Distance to Closest community Garden			

Which communities will benefit the most: Are there some low-income housing developments that could benefit?

Seed Selection Findings / Recommendations

Plant survival findings Indicate that some plants performed better than others. The table below indicates plant survival rates relative to the others planted. The best performing plants were Pumpkin, Dill, and Romaine lettuce. Pumpkin was exceptional filling up the garden with a low number of seeds. The crawling effect of the plant allowed it to fill in empty spaces where other seeds did not germinate. Similar plats like zucchini and squash would likely have the similar affects in future

Plant Name	Pumpkin	Dill (mammoth)	Bush Beans	Scarlette Runner Bean	Kale	Marigold	Chard, Northern Lights	Romain Lettuce
Recommended Planting Depth	1"	1/4" - 1/2"	2"-4"	1"	1/4" - 1/2"	1/4"	1/2" - 1"	1/8"
# of seeds planted (estimated)	250	1000	500	500	750	1600	1750	1600
Grams of seeds planted	70	3	140	140	3	3	28	3
Plant survival after 10 weeks	High	High	Zero	Very Low	Medium	Medium	Low	High

In the future trials, other plants to consider based on their planting depth and performance in nearby community gardens include: sunflower, beets, snow peas, zucchini, squash, carrot Based on our plant survival findings trail, below is a list of seed selection criteria that could be used to improve outcomes in future trials

Seed Selection Critera	Plant A	Plant B	Plant C
Plants likelyhood of being perceived as weeds			
Likelyhood of plant being identifie by people with little knowledge of gardening			
drought tolerance			
ability attract beneficial insects			
seed price			
seed size			
seed planting depth			
plant number need per square meter			

Other plant selection factors to consider include choosing a mix of plant heights and colors. Plants of various heights colors add to visual interest of a garden