ABSTRACT

BLUMENFELD, SAMUEL. Developing an Enterprise Budget Financial Tool for the Western North Carolina Christmas Tree Industry. (Under the direction of Dr. Solomon Ghezehei).

North Carolina is the second largest producer of Christmas trees (CT) nationally, and Western North Carolina (WNC) is the center of the state's production. Despite the industry's size, little economic information exists to assist growers, Extension agents, and associated industry. For North Carolina (NC), a 2008 CT Sample Budget is the most recent effort to document estimated costs of CT farms by operational category, which is now outdated due to industry changes. Because most CT growers lack knowledge of economics, updating a CT financial tool with current economic information is critical. Enterprise budgets are common financial tools that account for associated costs and revenues for an average acre of a given agricultural crop. While older sample budgets do exist for CT-producing states nationally, none of these sample budgets enable user modification of values in the fashion of a true enterprise budget. Due to the variable nature of CT farms, the flexibility provided by a user-modifiable enterprise budget is necessary to enable farm-specific financial analysis to growers. The Christmas Tree Financial Tool (CT-EB) was created to provide the framework necessary for growers to tally costs and revenues associated with growing an acre of Christmas trees to receive novel financial insight into their operation. The tool is tailored towards small-to-medium wholesale growers, a demographic with an identified need for financial assistance, but can be applicable for other CT operation types, both in North Carolina and elsewhere. CT-EB will serve as an Extension tool to assist CT growers in assessing the economic sustainability of their operations by enabling them to assess costs and revenues on a per acre basis, provide novel financial analysis of their operation, and assist growers in future farm planning.

Developing an Enterprise Budget Financial Tool for the Western North Carolina Christmas Tree Industry

by

Sam Blumenfeld

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APPROVED BY:

Dr. Solomon Ghezehei Committee Chair	Dr. Elizabeth Guthrie Nichols
Dr. Justin G. Whitehill	

BIOGRAPHY

I have always had a passion for the outdoors, sustainability, and conservation, and this love of protecting all things nature brought me to NC State in 2018 to complete my undergraduate degree in Natural Resources. Through classes and research experiences, I developed a passion for forest management, specifically the interconnectedness between ecology, economics, and communities utilizing forest products. My most formative undergraduate experience was working for the Tree Improvement Program, where I spent time in the field, greenhouse, and laboratory working to genetically improve loblolly pine through selective breeding. It was a natural next step to return to NC State for my master's degree in Natural Resources, where I would continue to explore various dimensions of forestry. My project's two components, refining growth, yield, and profitability models for *Populus*, as well as developing an enterprise budget financial tool for the Western North Carolina Christmas tree industry, enabled me to make a positive impact on research and landowners' livelihoods while furthering my knowledge of forest management. These experiences have led me to land an incredible post-graduate position as a Sustainability & Policy Analyst for The Westervelt Company, working to improve sustainability initiatives across their various operation groups.

ACKNOWLEDGEMENTS

I am indebted to my committee members, Drs. Solomon Ghezehei, Elizabeth Guthrie Nichols, and Justin Whitehill for their continued support and advice throughout this project. Other contributors to this project I must thank by name include Caleb Cochran, Dr. William Kohlway, Will Baldwin, Angela Chiang, Dr. Dennis Hazel, Travis Birdsell, Jeff Owen, and Jerry Moody. I would also like to thank the North Carolina Christmas Tree Association for their support. This study was funded by USDA NIFA Grant # 2022-0106 and the NC Department of Agriculture and Consumer Services

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CHAPTER 1: INTRODUCTION

Christmas tree (CT) farms operate in all 50 states within the United States and comprise nearly 300,000 acres across 15,000 farms while producing over $900 million in sales annually (Ag Census Data, 2019). North Carolina ranks second nationally in total acres of CT production with an estimated 40,000 acres, harvesting over 25% of trees nationally (Ag Census Data, 2019). Over 95% of CT grown in NC are Fraser fir (*Abies fraseri* [Pursh] Poir), a species endemic to high elevations of North Carolina and neighboring states (Weakley, 2023). The cool, moist conditions of the western mountain counties of Alleghany, Ashe, Avery, Buncombe, Haywood, Henderson, Jackson, Macon, Madison, Mitchell, Swain, Transylvania, Watauga, and Yancey enable operations of Fraser fir plantations (NCCTA, n.d.) and account for 91% of the state's Christmas tree acreage (Ag Census Data, 2019). While 85 out of the state's 100 counties report Christmas tree operations, this graduate research project focused on developing an enterprise budget economic tool for the CT industry in the 14 counties of Western North Carolina (WNC) (Ag Census Data, 2019).

Agricultural enterprise budgets provide cost and return estimates for farming operations. Enterprise budgets have been defined as the best financial tool to evaluate the potential profitability of a farming operation (Curtis et al, 2005). They provide an estimate of operational inputs and outputs and are reported on a per unit basis, such as an acre or head of livestock, and comprise both fixed and variable costs (Harper et al, 2019; Sharp, 2008). Fixed costs represent expenses independent of management decisions, including land, machinery, and overhead costs. Variable costs differ between management decisions, such as different fertilizer and insecticide brands and rates (Sharp, 2008). In addition to reporting average costs, enterprise budgets enable the user to modify the average values to their specific operation (Harper et al, 2019; Sharp, 2008).

State agriculture extension services publish enterprise budgets tailored to specific industries in their state (*Enterprise budgets*, n.d; *Enterprise budgets*, 2024; Washburn, 2023). The Ag Risk & Farm Management Library database provides nearly 4,000 enterprise budgets covering almost 200 crops. However, USDA-defined specialty crops, such as Christmas trees, are not listed in this database (Budgets, 2023). A national CT enterprise budget did exist in 2002 but is no longer available online (Risk Management Agency, 2002; Jeff Owen, personal comm.). Contrasting the popularity of enterprise budgets in other agricultural sectors, Christmas tree enterprise budgets are not available. Many CT sample budgets, including those from Oregon State (Cross, 1995), Michigan State (Nzokou & Leefers, 2006), North Carolina State (Owen, 2008), Penn State (Bates et al, 2013), and the University of Tennessee (Galloway et al, 2017), provide per-acre price estimations with varying levels of detail. Specifics on each sample budget are provided in **Table 1**. However, these sample budgets do not allow user customization and scenario modeling found in enterprise budgets.

Table 1. Comparison of various CT Sample Budgets.

	Oregon	North Carolina	Michigan	Pennsylvania	Tennessee
Pros	Costs given on a yearly basis. Costs divided by Labor, Machinery, and Materials.	Tailored to NC. Provides ranges for Operational Category costs.	Provides per acre and per tree cost estimates. Provides per acre cost estimates on management operations by year.	Allows user to tabulate cost estimates per year. Provides per acre cost estimates on management operations by year.	Breaks down costs by year and management operation. Provides costs of tools.
Cons		Does not provide details on yearly operations.			Tailored to half acre.

In NC specifically, the last CT sample budget was published in 2008 at: https://christmastrees.ces.ncsu.edu/christmastrees-ag95-v/ (Owen, 2008). Since its publication, various economic metrics and CT production practices have changed. Domestic inflation has increased by 42% (U.S. Bureau of Labor Statistics, n.d.). Simply adjusting the 2008 sample budget to account for nationwide inflation would not update the prices to today, as price increases are inconsistent through different operational categories. For example, the state's H2A hourly labor rate in 2008 was $8.85 (H-2A, 2015), and in 2023 was $14.91 (H-2A, 2023), representing a 68% increase, while the price of 1,000 3-1 Fraser Fir seedlings in 2008 from a certain vendor was $575 (Bosch's 2008) and in 2023 was $890 (Bosch's, 2023), representing a 55% increase.

In addition to inflation, industry-wide changes have occurred since 2008. For example, the industry has consolidated to fewer growers on larger farms (Travis Birdsell, personal comm.). The 2007 and 2017 Censuses of Agriculture indicated the average farm size increased from 30 to 46 acres, but this value is skewed by a high number of very small farms totally only a few acres and dilutes the increasing number of larger 100+ acre farms (Jeff Owen, personal comm.). Larger farms employ price-reducing economies of scale, such as purchasing resources in bulk and diluting fixed costs at a lower cost per production unit, leading to a reduced cost per unit (Duffy, 2009).

New management issues have arisen over the last 15 years. Loss of production to disease and pests incurs costs that limit profitability. The spread of *Phytophthora* sp. (PRR), a soil fungal disease to which Fraser fir is 100% susceptible (McKeever & Chastagner, 2016), significantly impacts what was once productive acreage. This disease has rapidly expanded since the late 1990s (Pettersson, 2017). PRR was detected at 57% of farms inventoried in a study in WNC between 1997-1998 (Benson 2000) and, in 2014, PRR detection increased to 80% of inventoried farms (Pettersson 2017). Some growers are replacing Fraser fir with less-susceptible CT species, but financial markets are not as strong for these species (Pettersson 2017).

Changes in the industry over the past 15 years, including the increase in average farm size, the spread of PRR, and changes in herbicide and pesticide use necessitate an updated inventory of operational costs and management practices. In a 2006 survey, 7 herbicides were reportedly sprayed on over 5% of total farm acreage. In a follow-up 2018 survey, Roundup® (Glyphosate) was the only herbicide applied on more than 5% of the total acreage (Sidebottom 2019). The pesticide Di-Syston 15 G® was reportedly used on 32% of acres in 2006 but has since been banned (Sidebottom, 2019). Sniper replaced Dimethoate as the most commonly reported herbicide, primarily to control outbreaks of the introduced and spreading pest hemlock elongate scale (*Fiorinia externa* Ferris) (Sidebottom, 2019). These changes in pesticide and herbicide use lead to changes in costs and the specific change in management practice should be documented.

Sample and enterprise budgets are region-specific. For example, Tennessee Extension's sample budget is written for white and Virginia pine (*P. virginiana* Mill) and does not include Fraser fir (Galloway et al, 2017). While Penn State University Extension's sample budget includes Fraser fir, the listed rotation age is 10 years and the planting density is 1,200 per acre. In NC, 7-8 years is a standard rotation with a planting density of 1,740 (Bates et al, 2013). The first and third-ranking states in Christmas tree production, Oregon and Michigan (Ag Census Data, 2019), respectively, have not updated their sample budgets since 1995 (Cross et al, 1995) and 2006 (Nzokou & Leefers, 2006).

Although one might argue the lack of CT sample and enterprise budgets stem from a lack of demand, North Carolina Extension agents state there is a need for an updated budget (Jeff Owen, personal comm; Travis Birdsell, personal comm.). Most growers have a solid understanding of the economic inputs and outputs of their entire operation, yet both Extension agents and growers agree that many growers lack this knowledge on a per-acre basis. Small growers would particularly benefit from an updated CT enterprise budget; they often lack accounting data to understand profitability consequences of management and production decisions (Travis Birdsell, personal comm.). An updated enterprise budget would enable the financial sector of the industry, such as banks, insurers, and land appraisers, to assess better a growers' finances with an in-depth per-acre analysis (Curtis et al, 2005). Furthermore, an enterprise budget can inform aspiring growers of the significant inputs, both financial and time, of beginning a Christmas tree operation (Travis Birdsell, personal comm.).

An enterprise budget tailored to North Carolina CT operations will fill a significant knowledge gap for growers, extension agents, and the financial sector. Based on this identified need, an enterprise budget tool was created. The enterprise budget financial tool (CT-EB) for Western North Carolina CT growers improves financial decision making as well as Extension agent's ability to provide advice related to financial assistance. The tool is targeted to small-to-medium sized wholesale growers. While published enterprise budgets generally provide average cost estimations, significant variations in CT farm management both among farms and within the same farm made developing an "average" CT budget and keeping it up to date too cumbersome and less accurate for end users. CT-EB instead provides the framework and flexibility for users to insert farm-specific values to assess how various potential changes in management operations influence costs and returns. CT-EB is a publicly available tool housed on the NC State Christmas Tree Extension website.

CHAPTER 2: METHODS

2.1 Methods Overview

CT-EB was created on Microsoft Excel 16.81 and used embedded VBA Code software. To create the tool, specific Operational Categories (e.g. planting, herbicide application, harvesting techniques) were designated; differing management practices and associated costs were developed for each category. Operational Categories and associated management practices were integrated from existing sample budgets and other Christmas tree resources (Bates et al, 2014; Cross; 1995; Nzokou & Leefers 2006; Owen 2008). Operational Categories for CT-EB were defined based on the NC State Extension 2008 Sample Budget. Specific management details, such as management details and associated costs were added from the NC State Christmas Tree Extension Website, as well as other university's extension pages, Limbs & Needles articles, and farm equipment supplier stores. A summary of where information was located from is provided in **Table 2.**

Table 2. Summary of where information used in CT-EB was found.

Management Detail	Source	Management Detail	Source
Land Cost	Grower Interviews		
Ground Cover Selections	NCSU Extension	Ground Cover Price	SeedWorld USA
Seedling Type, Price	Limbs & Needles Article; NC Forest Service; Grower Interviews	Planting Times	Virginia Tech Extension
Fertilizer Selections	NCSU Extension	Fertilizer Costs	Local Dealer
Herbicide Selections	NCSU Extension	Herbicide Costs	Local Dealer
Insecticide Selections	Limbs & Needles Article	Insecticide Costs	Local Dealer
Deer Management Selections	Limbs & Needles Article, NCSU Extension	Deer Management Costs	Online Sources
Shearing Time	Grower, Extension Agent Interviews		
Loading, Shipping Details	Grower, Extension Agent Interviews		

Table 2 (Continued).

Tool Selections	Grower, Extension Agent Interviews	Tool Costs	Online Sources
Operational Costs	2008 Sample Budget		

These details were compiled in appropriately placed locations within the Excel sheet, and citations are provided on the Sources Tab. NC Extension Agents Jeffrey Owen and Travis Birdsell provided invaluable information on how growers would benefit from the financial tool. Growers and NC State faculty were interviewed to provide feedback on how the usability of the tool could be improved.

2.2 CT-EB Assumptions

The primary objective of developing CT-EB was to create a financial tool where CT growers could input and tally costs associated with producing an acre of Christmas trees. The development process focused on providing the framework necessary to accommodate the inclusion of major operational costs and collecting and presenting this information in novel ways for users. As the first financial publication for the industry since 2008, the tool is designed to be widely applicable and targeted to user groups who would most benefit from it. Small-to-medium sized wholesale growers were identified as the target industry group for CT-EB, but other CT industry markets could use the tool as well, both within NC and elsewhere. **Table 3** lists the assumptions used when creating CT-EB.

Table 3. List of management assumptions used when creating CT-EB

Assumption	Why	Where Applicable
General:		
Farm is located solely in Ashe County	County with highest acres in production	Land Value, Land Tax

Table 3 (Continued).

Assumption	Why	Where Applicable
Wholesale farm	Previous sample budget tailored to wholesale	Rotation Length
No atypical event occurs during the rotation, such as a PRR outbreak, heavy deer browse, or another event that drastically changes management inputs	Enterprise budget to document "business as usual" operations	
The acre accounted for is 100% stocked with trees, and there are no roads or areas not planted within this acre	Enterprise budgets are traditionally constructed for an acre fully in production	
There are no changes in price of goods, labor, or trees between years	Accounting for these market fluctuations not in scope of enterprise budget	
The land mortgage has fully been paid off	Most land has remained in same family farm for years	Land Value
Loans are taken for all expenses evenly	Challenging and time consuming to ask which specific costs have loans at which rates	Interest on Loans
Management Details and Assumptions		
Trees harvested in less than 9 years	Typical for wholesale	Harvest Assumptions, Rotation Length
20% Required Rate of Return	Considers standard interest rate + additional risk assessment rate associated with agricultural crop	Required Rate of Return and all NPV equations
Farm has 75 acres, all in Christmas trees	Average size for a medium-sized farm	Equipment Costs, Labor Costs
10% Mortality Rate Years 1-2, and none from PRR	Enterprise budget to document "business as usual" operations	Replants Year 2 accounts for 100% replanting from First Year Mortality

Table 3 (Continued).

Assumption	Why	Where Applicable
Operational Categories		
There is no overtime pay	Unfortunately, there was no practical way to account for overtime pay in the developed budget. As a result, labor costs will likely be undercounted. To remedy this issue, a user could modify the hourly wage to account for overtime pay	Labor costs
All Replants Year 2 cost the same as the average seedling price in Year 1, and there is no replanting after Year 2	This average was the most practical way to calculate Year 2 seedling prices, although this value can be modified if need be	Seedling Costs, Planting Costs
All operational costs and equipment costs are divided evenly over the farm's total acres	Fixed costs always dispersed evenly in enterprise budgets	Operational Costs, Equipment Costs

2.3 Spreadsheet Layout

CT-EB was developed as an Excel-based tool that allows CT growers to tally all inputs associated with growing an acre of Christmas trees and enables user-modifications (as opposed to a more rigid enterprise budgeting that provides industry-wide averages). The tool uses multiple worksheet tabs for ease of use and presentation and includes interactive features to allow users easy navigation and input modification. **Table 4** describes each worksheet tab and its role in the tool.

Table 4. Description of contents in each worksheet tab of the Excel-based CT-EB.

Worksheet Tab	Description of CT-EB Contents
Instructions/Assumptions	Instructions for users and assumptions used/included.
Management Assumptions	User-modified operational details, such as planting density, farm acres, and rotation length. User-modified matrix of trees harvested per year and prices.
Interactive Decision Sheet	Snapshot of costs/year of each Operational Category to be modified by users.
User Worksheet	List of currently used management practices. Enables user modification to reflect specific operational details.
Costs and Timeline	Tabulated costs per year by Operational Category. Operational Categories: Land Value, Labor Costs, Seedling Costs, Planting Costs, Mechanical Site Preparation Costs, Ground Cover Costs, Fertilizer Costs, Herbicide Costs, Insecticide Costs, Mowing Costs, Deer Management Costs, Cone Management Costs, Shearing Costs, Harvesting Costs, Loading/Shipping Costs, Operational Costs, Equipment Costs, Miscellaneous Costs.
Itemized Cashflow Report	Tabulated costs by Operational Category for rotation, yearly revenues and costs, cost per harvested tree by year, graphs of income per year, labor hours by Operational Category by year.
Operator Worksheet	Includes all values in User Worksheet linked to cells user-modified inputs to allow for easy updates of prices and management choices.

Due to the intended user demographic, Christmas tree growers who typically are older and less technologically proficient, the tool's development emphasized ease of access. Microsoft Excel's VBA Code software was used to create navigational buttons to transfer between various tabs and Add/Clear selections for choosing various management inputs are prevalent throughout

CT-EB to facilitate easy use. Instruction text boxes guide a user through all necessary steps. A common issue with publicly available spreadsheets is the accidental “destruction” of a cell’s code by the user. While other spreadsheets have navigated this issue by using the “protect cell” function, the integrated VBA Code buttons prevented the use of this common workaround. Instead, each Operational Category Worksheet in the User Worksheet Tab contains an embedded “Restore Template Values and Code” button. If a cell’s functionality is destroyed, a user can click this button to restore the specific Operational Category Worksheet to its originally published form. This reset workaround is made possible through the User Worksheet Copy Tab. If CT-EB were to be updated in the future, the User Worksheet Copy Tab must be updated through running the procedure: Developer→VBA Basic→Modules→Template→Sub_Update_User_Worksheet_Copy. This procedure copies the newly updated User Worksheet Tab to the User Worksheet Copy Tab, which then allows for the recopying of the User Worksheet Copy Tab with the “Restore Template Values and Code” button.

The embedded VBA Code contains three Modules of code based on category. The Sheet_Interactions Module contains code for the various navigational buttons that assist movement between tabs as well as the “Restore Template Values and Code” buttons. The Template Module stores the Update_User_Worksheet_Copy code mentioned previously. The Worksheets_New Module stores all Add and Clear button codes throughout the spreadsheet. Each set of code has a provided description to allow for easier troubleshooting or later modification.

2.4 NCCTA Survey Asking Growers about CT-EB

A poster session presentation at the 2023 Summer North Carolina Christmas Tree Growers Association meeting in Spruce Pine, NC showcased the tool in a developmental stage. An anonymous convenience survey asked growers about their thoughts on the tool, asked after growers interacted with the poster. The survey questions are asked below in **Table 5.** In addition to this survey, casual engagement with growers interested in the poster occurred and was documented. Results from the survey and casual engagement are provided in **Section 3.4.**

Table 5. Questions asked to growers at the NCCTA 2023 Summer Meeting survey.

Do you currently use any financial tools for your operation?
How knowledgeable are you of your financial operations on a per acre basis?
How variable are your finances between different fields?
What features of an enterprise budget (or financial tool in general) would you find most beneficial?

CHAPTER 3: RESULTS

3.1 Management Assumptions Tab

The initial step in completing CT-EB is filling out the Management Assumptions Tab. Users fill out farm-level details, as shown in **Figure 1**, and a Harvesting Matrix with estimated price, size, and years for harvesting trees, as shown in **Table 6,** to accurately reflect their farm and acre of interest.

Management Details and Assumptions			
Planting Spacing	5x5	Mortality Rate Years 1-2	10%
Planting Density (Acre)	1740	Mortality Rate Years 2+	15%
Rotation Length (Years)	8	Total Trees Harvested	1479
Required Rate of Return (%)	6.00%		
Loan Interest Rate(%)	7.50%		
Total Acres of Farm (In All Crops)	75		

Figure 1: Management Details and Assumptions matrix on farm-level details, with pre-programed "average" values that a user can modify as needed.

Table 6: Harvesting Matrix partitioned by tree size, grade, average tree price, and harvest year.

Total Trees Harvested	1479	Percentage of Acre Harvested in Grade and Size by Year								Total % of Trees Harvested	Total Trees Harvested by Size/Grade
Tree Size	Grade	Average Tree Price	3	4	5	6	7	8	9		
2-4 ft/Table Top										0%	0
4-6 ft	1 Grade									0%	0
	2 Grade									0%	0
	Cull Grade									0%	0
6-7 ft	1 Grade									0%	0
	2 Grade									0%	0
	Cull Grade									0%	0
7-8 ft	1 Grade									0%	0
	2 Grade									0%	0
	Cull Grade									0%	0
8-10 ft	1 Grade									0%	0
	2 Grade									0%	0
	Cull Grade									0%	0
10-12 ft	1 Grade									0%	0
	2 Grade									0%	0
	Cull Grade									0%	0
12-14 ft	1 Grade									0%	0
	2 Grade									0%	0
	Cull Grade									0%	0
14-16 ft	1 Grade									0%	0
	2 Grade									0%	0
	Cull Grade									0%	0
Other										0%	0
		Total %	0%	0%	0%	0%	0%	0%	0%	0.00%	0

To complete the Management Assumptions Tab, a user would modify both the Management Details and Assumptions and Harvesting Matrix to accurately reflect their operation. Depending on the specific cell input, users either manually input a value or are provided pre-selected options through down drop selections. User-inputted information from the Management Assumptions Tab is carried throughout the rest of the spreadsheet, and cells such as "Total Trees Harvested" and the longest rotation year are critical for completing the remainder of CT-EB.

3.2 Operational Categories Tab

Similar to existing enterprise budgets, CT-EB partitions costs by Operational Categories. The Operational Categories were modified from the categories listed in the 2008 Sample Budget (Owen, 2008). These Operational Categories remain partitioned throughout CT-EB to enable users to easily input and understand costs associated with Operational Category. **Table 7** provides a list of all Operational Categories. Unless specified with an asterisk, each Operational Category calculates and presents costs from Years 0-9, dependent on user inputs. Growers complete each Operational Category individually in the User Worksheet Tab.

Table 7. Description of each Operational Category and associated costs

Operational Category	**Associated Costs**
Land Value	Land Value, Land Tax
Labor Costs	H2A Worker Cost/Acre
Planting Costs*	Costs (Initial and Replants), Physical Planting Costs
Site Preparation Costs**	Site Preparation Costs
Ground Cover Costs	Ground Cover Costs
Fertilizer Costs	Fertilizer Costs
Herbicide Costs	Herbicide Costs
Insecticide Costs	Insecticide Costs
Deer Management Costs	Deer Management Costs
Cone Management Costs	Cone Management Costs
Shearing Costs	Shearing Costs
Harvesting Costs	Harvesting Costs
Loading/Shipping Costs	Loading/Shipping Costs
Operational Costs	Dues/Subscriptions/Annual Fees, Insurance, Marketing, Utilities, Overhead
Equipment Costs	Equipment Costs
Miscellaneous Costs	Miscellaneous Costs

*Planting Costs are tallied only for Years 1, 2, and 3
**Site Preparation Costs are tallied only for Year 0

Each Operational Category contains a cell matrix designed to encompass costs associated with the specific operation. Each Operational Category cell matrix differs based on specific costs as well as how growers would likely best understand and be able to insert values from their operation. The specific inputs requested were curated from information growers would likely know, such as prices for goods, and time (labor wages) spent completing various tasks. A full description of the cell matrix for each Operational Category can be found in **Appendix I.**

3.3 Itemized Cost Report Tab Results

Upon completion of the Operational Categories in the User Worksheet Tab, a user navigates to the Itemized Cost Report Tab to access graphs and charts that may provide novel insight into their operation. While each user's operations differ and no two results may look the same, provided below are examples of the various outputs of CT-EB based on a hypothetical farm. The figures and tables on the following pages will show the various end products, visible on the Itemized Cost Report Tab, once a grower completes the tool. *Note: these reports are not representative of an actual Christmas tree farm and should not be interpreted as such.*

Table 8 shows a breakdown of costs by Operational Category. It enables landowners to view the associated operational costs by specific production type.

Table 8. Table of breakdown of costs of by Operational Category.

Operational Category	Item		Present Value Costs
Land Costs	Land Value		$1,645.60
	Land Taxes		$9.19
		Total	**$1,654.79**
H2A Worker Costs		***Total***	$0.00
Site Preparation Treatments	Site Preparation		$50.00
	Ground Cover		$76.73
		Total	**$126.73**
Planting Costs	Planting Stock		$1,976.01
	Physical Planting		$1,125.53
		Total	**$3,101.53**
Mid-Rotation Stand Treatments	Fertilizer (Acre)		$807.40
	Herbicide (Acre)		$2,378.19
	Insecticide (Acre)		$351.28
	Deer Management (Acre)		$540.09
	Cone Management (Acre)		$0.00
	Mowing (Acre)		$0.00
	Shearing (Acre/Year)		$1,694.88
		Total	**$5,771.84**
Harvesting Costs		***Total***	**$5,680.97**
Equipment Costs	Diesel		$0.00
	Tools		$1,043.24
		Total	**$1,043.24**
Operational Costs	Dues/Subscriptions/Fees		$72.10
	Insurance		$0.00
	Marketing (Year)		$0.00
	Overhead (Year)		$33.45
	Utilities		$230.71
	Interest on Loans		$1,328.65
		Total	**$1,664.92**
Miscellaneous Additional Expenses		***Total***	**$0.00**
	Total Input Costs per Acre		**$19,044.01**

Figure 2 shows a breakdown of costs by Operational Category in a pie chart. Cataloguing costs in this fashion allows growers to see how various Operational Categories comprise a portion of the total costs.

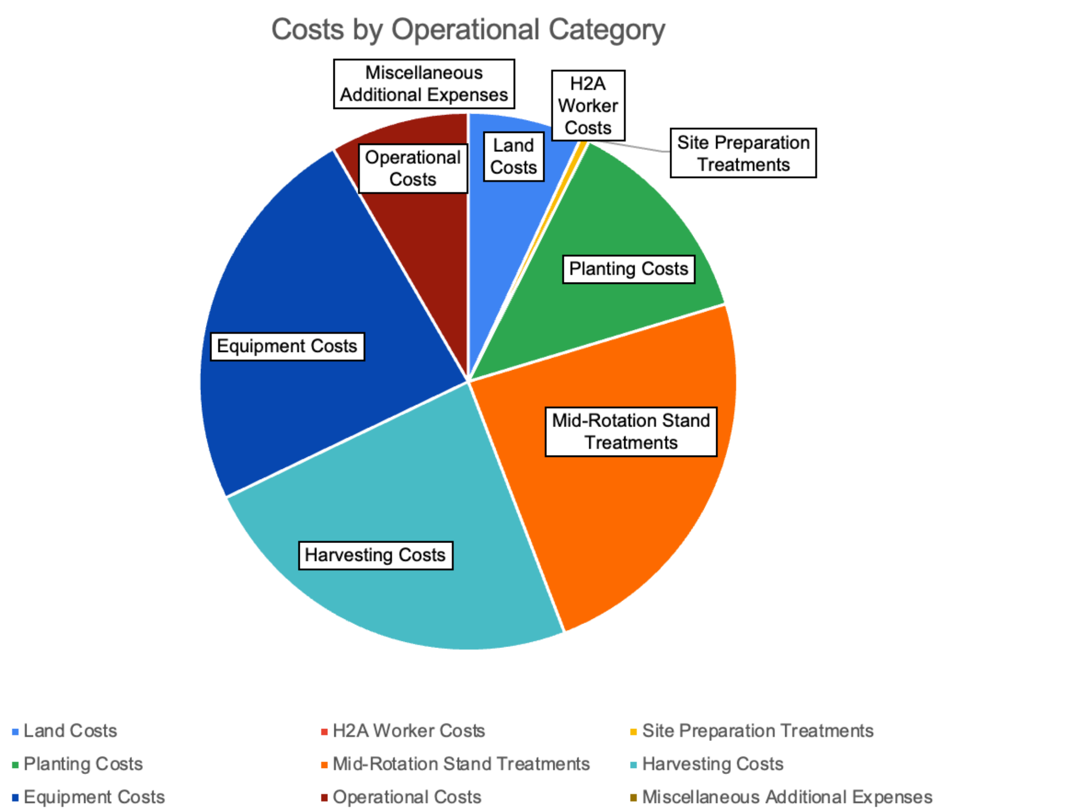

Figure 2. Pie chart of breakdown of costs by Operational Category.

Figure 3 shows a stacked bar chart of labor hours, broken down by year and Operational Category. The stacked bar chart enables growers to easily see the labor associated with various tasks and total labor per year.

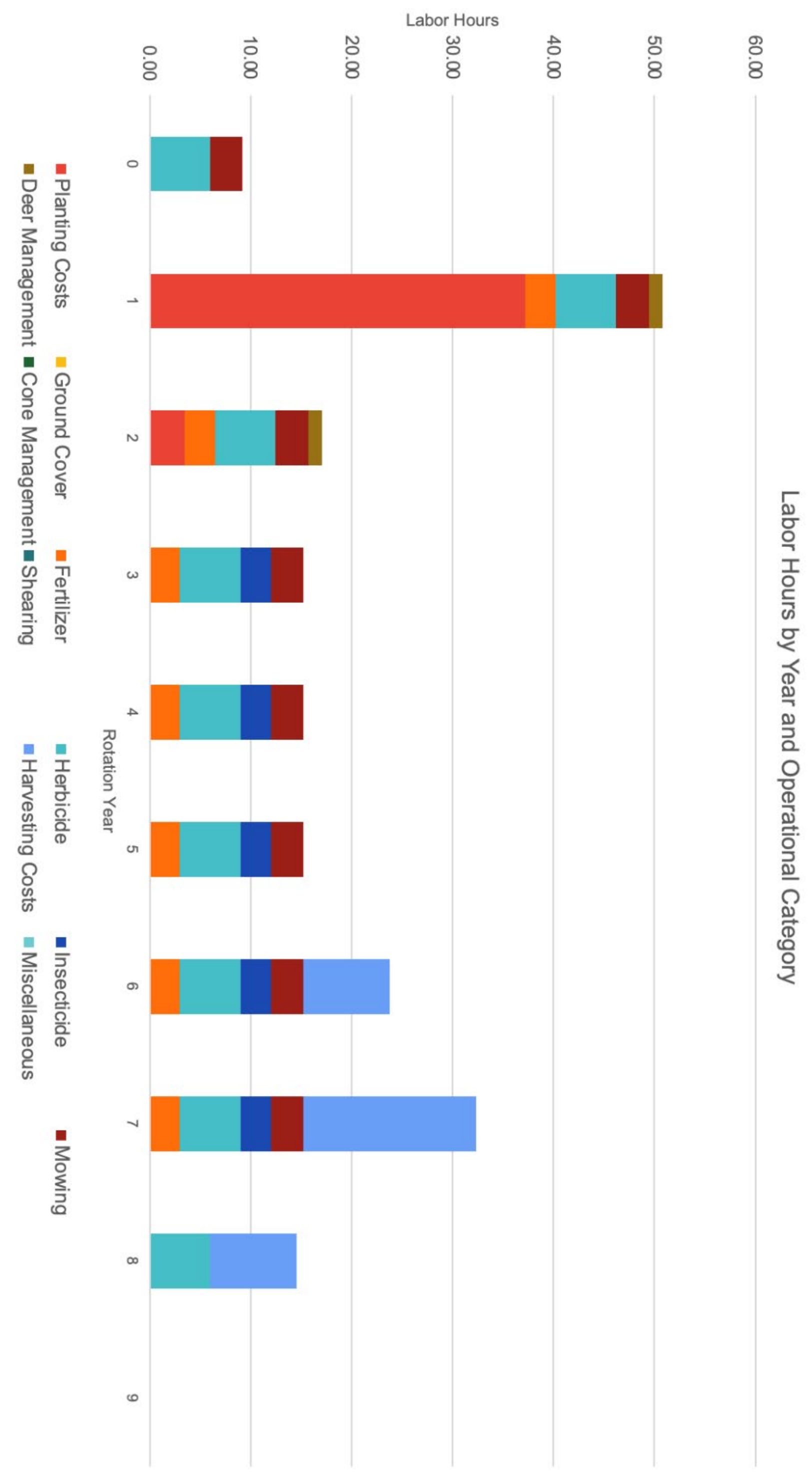

Figure 3. Stacked bar chart of labor hours by year and Operational Category.

Table 9 shows a breakdown of labor hours by Operational Category and year. The table enables growers to easily see the values associated with labor hours by year and Operational Category.

Table 9. Table of breakdown of labor hours by year and Operational Category.

Labor Hours:

Year:	Planting Costs	Ground Cover	Fertilizer	Herbicide	Insecticide	Mowing	Deer Management	Cone Management	Shearing	Harvesting Costs	Miscellaneous	Total
0	0.00	0.00	0.00	6.00	0.00	3.22	0.00	0.00	0.00	0.00	0.00	9
1	37.22	0.00	3.00	6.00	0.00	3.22	1.41	0.00	0.00	0.00	0.00	51
2	3.48	0.00	3.00	6.00	0.00	3.22	1.41	0.00	0.00	0.00	0.00	17
3	0.00	0.00	3.00	6.00	3.00	3.22	0.00	0.00	0.00	0.00	0.00	15
4	0.00	0.00	3.00	6.00	3.00	3.22	0.00	0.00	0.00	0.00	0.00	15
5	0.00	0.00	3.00	6.00	3.00	3.22	0.00	0.00	0.00	0.00	0.00	15
6	0.00	0.00	3.00	6.00	3.00	3.22	0.00	0.00	0.00	8.56	0.00	24
7	0.00	0.00	3.00	6.00	3.00	3.22	0.00	0.00	0.00	17.12	0.00	32
8	0.00	0.00	0.00	6.00	0.00	0.00	0.00	0.00	0.00	8.56	0.00	15
9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0
Total	40.70	0.00	21.00	54.00	15.00	25.73	2.82	0.00	0.00	34.24	0.00	193

Table 10 shows a breakdown of yearly revenue, costs, and income. It enables growers to see in detail the associated revenue, costs, and income by year.

Table 10. Breakdown of yearly income.

	Present Value Revenue	0	1	2	3	4	5	6	7	8	9	Total Revenue
Table Top	$0.00											$0.00
4-6 ft	$0.00											$0.00
6-7 ft	$16,269.53							$8,874.00	$8,874.00			$17,748.00
7-8 ft	$5,232.31								$5,546.25			$5,546.25
8-10 ft	$8,720.52									$9,243.75		$9,243.75
10-12 ft	$0.00											$0.00
12-14 ft	$0.00											$0.00
14-16 ft	$0.00											$0.00
Other	$0.00											$0.00
	Yearly Revenue	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$8,874.00	$14,420.25	$9,243.75	$0.00	
	Yearly Costs	$723.38	$2,116.05	$1,286.74	$1,211.81	$1,199.46	$1,309.87	$6,075.96	$10,566.03	$5,443.01	$0.00	
	Yearly Income	-$723.38	-$2,116.05	-$1,286.74	-$1,211.81	-$1,199.46	-$1,309.87	$2,798.04	$3,854.22	$3,800.74	$0.00	

Figure 4 shows a histogram of present value income by year. It allows growers to easily visualize the yearly income.

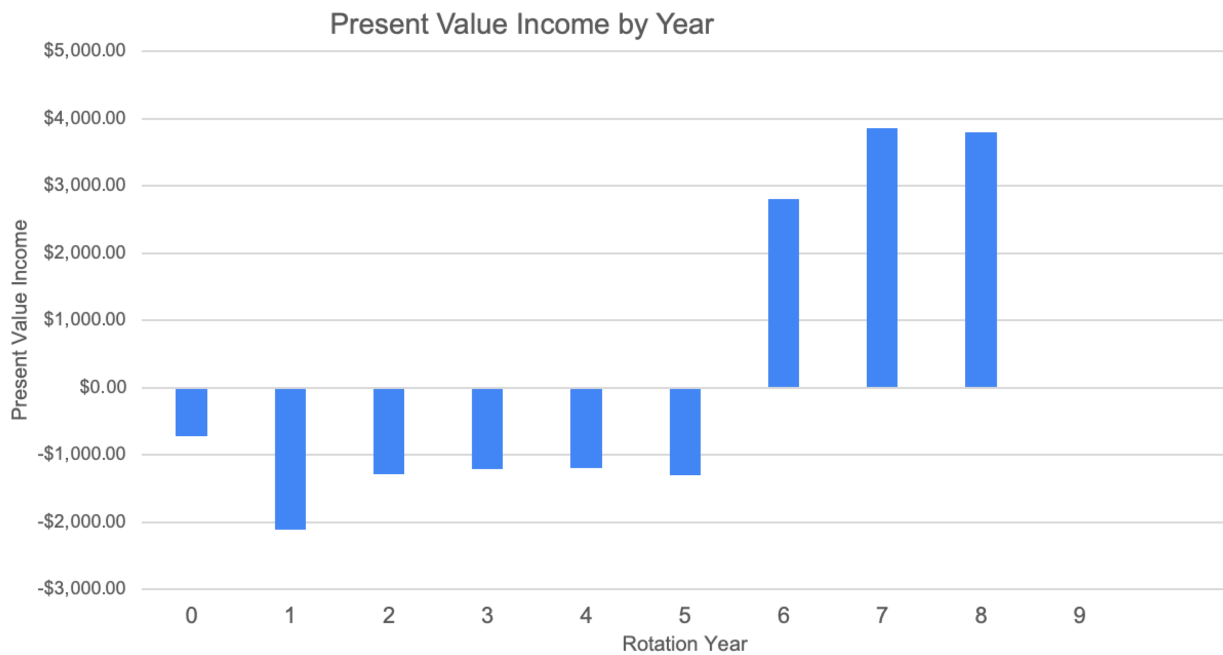

Figure 4. Histogram of present value income by year.

Table 11 shows the costs associated with one harvested tree by both year and throughout the rotation.

Table 11. Table of cost per harvested tree by year.

Cost/Harvested Tree	Year	
	0	$0.60
	1	$2.99
	2	$1.32
	3	$0.93
	4	$0.92
	5	$1.00
	6	$2.67
	7	$3.84
	8	$2.54
	9	$0.00
	Total NPV Cost/Tree	**$16.80**

Table 12 provides a summary of the present value revenue, costs, and income per acre. It allows growers to easily view these financial values.

Table 12. Summary of total revenue, costs, and income per acre.

Present Value Revenue:	$29,243.03
Prevent Value Costs	$17,966.05
Total Income per Acre	$11,276.98

Table 13 shows a detailed table of the costs associated with each Operational Category, by year and the present value of the whole rotation.

Table 13. Costs and Timeline Tab, which aggregates all operational costs by year and category.

Operational Category	Item	Present Value Costs	Yearly Costs	0	1	2	3	4	5	6	7	8	9	Total Costs
Land Costs	Land Value	$1,645.60		$250.00	$250.00	$250.00	$250.00	$250.00	$250.00	$250.00	$250.00			$2,000.00
	Land Taxes	$9.19		$1.28	$1.28	$1.28	$1.28	$1.28	$1.28	$1.28	$1.28	$1.28		$11.48
H2A Worker Costs	H2A Worker Costs	$0.00												$0.00
Site Preparation Treatments	Site Preparation	$50.00		$50.00										$50.00
	Ground Cover	$76.73			$81.33									$81.33
Planting Costs	Planting Stock	$1,976.01			$1,914.00	$191.40								$2,105.40
	Physical Planting	$1,125.53			$930.42	$278.40								$1,208.82
Mid-Rotation Stand Treatments	Fertilizer (Acre)	$807.40			$119.68	$149.71	$149.71	$149.71	$149.71	$149.71	$149.71			$1,017.94
	Herbicide (Acre)	$2,378.19		$329.86	$329.86	$329.86	$329.86	$329.86	$329.86	$329.86	$329.86	$329.86		$2,968.70
	Insecticide (Acre)	$351.28					$96.50	$92.90	$92.90	$92.90	$92.90			$468.08
	Deer Management (Acre)	$540.09			$294.58	$294.58								$589.17
	Cone Management (Acre)	$0.00												$0.00
	Mowing (Acre)	$0.00												$0.00
	Shearing (Acre/Year)	$1,694.88				$128.39	$256.77	$256.77	$359.48	$513.54	$410.83	$410.83		$2,336.61
Harvesting Costs	Harvesting Costs (Total)	$6,263.86								$2,246.74	$4,493.49	$2,696.09		$9,436.33
Equipment Costs	Diesel													
	Tools	$1,043.24		$144.70	$144.70	$144.70	$144.70	$144.70	$144.70	$144.70	$144.70	$144.70		$1,302.28
Operational Costs	Dues/Subscriptions/Fees	$72.10		$10.00	$10.00	$10.00	$10.00	$10.00	$10.00	$10.00	$10.00	$10.00		$90.00
	Insurance	$0.00												$0.00
	Marketing (Year)	$0.00												$0.00
	Overhead (Year)	$33.45		$4.64	$4.64	$4.64	$4.64	$4.64	$4.64	$4.64	$4.64	$4.64		$41.76
	Utilities	$230.71		$32.00	$32.00	$32.00	$32.00	$32.00	$32.00	$32.00	$32.00	$32.00		$288.00
	Interest on Loans (Year)	$1,372.37		$61.69	$308.44	$136.12	$95.66	$95.39	$103.09	$283.15	$443.95	$272.20		$1,799.69
Miscellaneous Additional Expenses		$0.00												$0.00
			Total Yearly Costs	$884.15	$4,420.91	$1,951.07	$1,371.10	$1,367.23	$1,477.64	$4,058.51	$6,363.35	$3,901.60	$0.00	$25,795.57

3.4 Results from NCCTA Survey Asking Growers about CT-EB

Listed below are the survey questions and results from the NCCTA Survey in Spruce Pine, NC. While participation was fairly low (n=4), survey results still illuminate insight into the industry and grower's thoughts on the tool. 50% of growers reported to use a financial tool for their operation. 75% of growers reported that they were "somewhat knowledgeable" about their finances on a per acre basis, 25% reported that they were "not knowledgeable," while 0% reported to be "very knowledgeable." When asked how variable were a grower's finances between different fields, 75% of growers reported that there was "some variation," 25% reported there to be "little to no variation," and 0% reported there to be "no similarity." Growers were also asked to select all of the potential features of CT-EB that they would find beneficial. 100% of growers reported that "per-acre cost and revenue estimates" and "cost breakdown by category" features would be beneficial, while 75% of growers responded positively to "cash flow timeline summary," "operational change scenario modeling," and "per-acre values for use with financial world." In casual engagement with growers viewing the poster, a section of growers were very interested in its content, however, most growers seemed to only quickly interact before moving on.

CHAPTER 4: DISCUSSION

4.1 Benefit to Growers

Enterprise budgets are commonly used to assist agricultural producers estimate operational costs and returns and better understand their finances and is considered the best financial tool to evaluate potential profitability of an operation (Curtis et al, 2005). The large number of published budgets demonstrates their popularity in the agricultural industry, and the number of Extension agencies that publish enterprise budgets for various crops and regions highlights their specificity (Budgets, 2023). Despite the popularity of enterprise budgets in other agricultural commodities, the lack of enterprise budgets in the CT industry is a noteworthy gap. Financial planning tools in general are lacking in the WNC CT industry; as stated previously, there has not been a published financial tool for the WNC CT industry since 2008, and a majority of growers lack experience in economics (Owen, 2008). While tailored to small-to-medium wholesale Fraser fir operations in WNC, this tool could be used as the framework to assess CT operations elsewhere nationally, providing a needed enterprise budget to the national industry. Below are benefits gained by CT growers using CT-EB:

- Evaluate per acre costs, revenues, and income for a standard acre by entering all typical management operations. By assessing a typical acre, growers have a better understanding of the financials and timeline on a per acre basis.
- Evaluate per acre costs, revenues, and income for an atypical acre by modifying the initial management operations based on an atypical scenario. Growers can compare the finances for this atypical acre against a typical acre to assess how the atypical acre will change returns.

These atypical incidents include but are not limited to high incidences of deer browse, *Phytophthora* spp. infestation, or negative climactic issues associated with climate change.

- Assess trends in management costs by completing tool each year and comparing to past years to increase efficiency. Over multiple years, growers can assess operation areas that have changes in costs to better understand and predict future changes.
- Assess cost/tree values by year and over the entirety of the rotation. Both growers and Extension agents alike have stated that a per tree value would be incredibly valuable and fill a knowledge gap for most growers. Knowing the total cost per tree can help growers better assess market prices.
- Compare costs of different management inputs, such as applying different fertilizers or herbicides, over the course of the rotation by modifying which inputs are used. Evaluating the long-term costs of various management inputs can improve grower's decision making on which products to use.
- Evaluate the current value of a stand at a mid-rotation age. If grower engages in a form of mid-rotation land rental, assessing all previous cost/revenues versus future costs/revenues can better assign a rental price. Alternatively, if grower is looking to sell their land, understanding the current value of trees on it can better assign a price.
- Assess the per acre value of a stand for interacting with the financial realm, whether that be for a loan or value of the land. The ability to produce accurate per acre evaluations and future cash flow projections can strengthen applications for loans or valuations of the land.
- Increase ease of tax evaluations with CPAs. Having documentation on yearly losses and profits can greatly increase the ease of navigating tax season.

- Evaluate predicted yearly labor hours required to prepare for future labor needs. With labor shortages often serving as a limiting factor in operation expansion, predicting future labor needs assists growers in evaluating and accounting for future labor.
- Compare costs by operational category and by year. Identify costly categories where attention could be spent to reduce costs. Growers can identify operational categories where they spend more than anticipated and consider cost-saving mechanisms.
- Visualize a timeline of costs/returns by year to prepare for rotation-long cash flow. Growers can better assess the rotational cash flow on a per acre basis.

4.2 Discussion of Engagement with Extension Agents and Christmas Tree Growers

Early consultation with NC State Extension Agents Jeff Owen and Travis Birdsell identified that an enterprise budget could work to solve the lack of financial literacy in the industry. Results from the Summer 2023 NCCTA Conference Survey corroborate this statement, indicating that growers typically do not have a great understanding of their operation's financials but believe an enterprise budget would be beneficial. Additionally, further engagement with Christmas tree growers in casual settings at the conference and in one-on-one meetings confirmed the value of an enterprise budget in improving the financial understandings of their operations.

The results of the NCCTA survey show promise that CT-EB could fill a knowledge gap of the industry by providing novel financial information to growers. Considering the large financial investment in Christmas tree operations, and that for most growers this is their main source of income, it is concerning that only 50% of growers indicated that they use any financial tools. It is also apparent that most growers do not have a great understanding of their finances on a per acre basis, as no respondents reported to be "very knowledgeable" on this subject. The results from these two survey questions indicate the need for a financial tool for the industry.

Of significant interest in the survey results is that growers indicated they might benefit from the specific features of financial insight provided by CT-EB. All categories of features provided by CT-EB received >75% interest from survey respondents, indicating that these features could be beneficial to growers. 100% of respondents indicated that they would be "somewhat likely" to incorporate the published financial tool into their financial planning, indicating that there is interest in the tool. The lack of significant variation of costs between fields suggests that growers likely might complete only 1 rendition of CT-EB for all fields, barring atypical fields, as opposed to multiple renditions if there were to be more variation between fields. Reducing the time necessary to gain the financial insight by only needing to complete 1 rendition of CT-EB could make the tool more attractive to potential users.

4.3 Future Updating of CT-EB

It is the author's hope that CT-EB is a viable and useful tool for the WNC Christmas tree industry. While no reporting was found to suggest the adaptation of enterprise budgets in any given field, the sheer number of enterprise budgets published suggest they are a widely used tool (Budgets, 2023). However, a common issue with enterprise budgets in general is that without routine updates, price assumptions quickly fall out of date. If CT-EB remains popular in the future, the tool has been designed to easily update prices as necessary. The tool's Operator Worksheet Tab facilitates price modification as necessary. Prices on this tab link back to selections available on the Interactive Decision Sheet Tab that a user would interact with and are organized and presented in a more modifiable-friendly way. Extension agents or a future graduate student could adjust prices as needed via the Operator Worksheet Tab to ensure CT-EB remains up to date on industry prices. Embedded VBA Code also includes text descriptions to direct any required future modification to the code.

CHAPTER 5: CONCLUSION

CT-EB was developed to assist grower decision-making in the WNC CT industry by allowing growers to better assess the financial sustainability of their operation. Through both conversation with Extension agents and results from the NCCTA survey, a financial tool is needed for the industry. As the first attempt of an industry-wide financial tool in some time, CT-EB was tailored to the greatest market need, small-to-medium wholesale growers. The tool's development focused on creating the framework necessary for documenting and cataloging costs and revenues associated with growing an acre of Christmas trees. Users completing CT-EB receive novel insight into the finances of their operation.

Due to the complex nature of CT-EB and its root as an extension project, growers likely will interact with Extension agents to complete the tool. Extension agents are in a unique position to serve as a currier between research and industry by assisting growers in completing CT-EB and can illustrate to growers the various applications of this resource to maximize its efficacy. A link to CT-EB and an article written for CT growers describing the tool is available on Dr. Justin Whitehill's Christmas Tree Genetics webpage at: [still waiting on link] The website portal also consists of an anonymous feedback form growers can complete to improve potential future iterations of the tool, as well as the ability for growers to anonymously submit a completed version of CT-EB. Growers submitting a completed version of the tool can assist Extension agents in better understanding specific operations commonly used across the industry in an anonymous manner.

While the current version of CT-EB provides a framework for users to enter operation-specific values, a future iteration of CT-EB could provide template values representing industry standard values. To assign these template industry standard values, enough growers would need to provide completed versions of CT-EB and/or a future researcher conducts interviews to assess industry norms. Completing an entire template budget would allow for the publishing of a true enterprise budget that provides industry-wide cost estimations by Operational Category and assign an estimated per acre net present value return value. An additional modification that would further improve CT-EB's efficacy would be to expand the timeline past Year 9 for rotation lengths. Lengthening the timeline would allow for growers to account for longer rotation times, which often occurs, often for growing larger trees. An initially unforeseen coding issue with Excel prevented the inclusion of longer rotation lengths for this initial version, however, a workaround to this issue is described in **Appendix II**. Ultimately, this initial version of CT-EB is intended to be adapted by future researchers to further improve the tool's efficacy in assisting CT growers improve the economic understanding of their operation.

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APPENDIX I. OPERATIONAL CATEGORY CELL MATRICES AND ASSOCIATED INPUTS AND CELL INTERACTIONS

Management Details and Assumptions:

Planting Spacing dropdowns are provided based on typical planting spacings.

Planting Density (Acre) value is calculated from *Planting Spacing*. Users can modify this value if their planting density differs from an available option.

Rotation Length (Years) indicates the maximum age trees are harvested. Due to limitations in coding, the maximum rotation length is 9 years. Future iterations of this budget could be coded for longer rotations if a need exists.

Required Rate of Return is the minimum return % a grower expects to receive to maintain a livelihood. Instead of the standard discount rate % often used when calculating Net Present Value (NPV), the required rate of return is a higher value to account for the increased risk associated with the industry. This value is used for all NPV equations.

Total Acres of Farm (In All Crops) asks for all acres owned. This value is used to divide all fixed costs, including Equipment Costs, Operational Costs, and H2A Worker Costs to a per acre value.

Mortality Rate Years 1-2 asks for the mortality rate in the first year after planting. The calculated number of trees, based on this percentage and *Planting Density (Acre)*, is accounted for in # *Trees Replanted* in the **Planting Worksheet.**

Mortality Rate Years 2+ asks for the mortality rate after year 2. No trees are automatically accounted for in # *Trees Replanted* in the **Planting Worksheet**.

Total Trees Harvested accounts for all trees harvested during the rotation. This value is calculated by the equation: (*Planting Density (Acre)* - (*Mortality Rate Years 1-2* + *Mortality Rate Years 2+*)) + (*Replants Year 2* + *Replants Year 3*).

Harvesting Matrix:

Total Trees Harvested is the same value as *Total Trees Harvested* in **Management Details and Assumptions.**

Tree Size breaks down trees sold by typical sizes. If sizes for your operation differ, we ask you to account for these discrepancies where you see fit, likely in the *Average Tree Price* and *Percentage of Acre Harvested in Grade and Size by Year* columns.

Grade allows for greater detail in accounting for tree prices.

Average Tree Price asks for the average price per *Tree Size* and *Grade*. Users should input these values to reflect their operation.

Percentage of Acre Harvested in Grade and Size by Year allows users to modify the percentage of trees harvested by each category. These percentages will be converted into individual tree numbers using *Total Trees Harvested*, and will be accounted for in later values such as **Harvesting Revenue** and **Harvesting Costs.** Users should input these values to reflect their operation.

Total % of Trees Harvested calculates the % of trees harvested by *Tree Size* and *Grade.*

Total Trees Harvested by Size/Grade calculates the number of trees by *Tree Size* and *Grade* by the equation: *Total % of Trees Harvested * Total Trees Harvested.*

Total % calculates the total percentage in the *Percentage of Acre Harvested in Grade and Size by Year*. If the user-modified value does not equal 100%, this row will flash red.

Land Value Worksheet:

Ownership Type accounts for the 2 main ownership types, “Own” and “Rent.” While we recognize there are many forms of land rental, to simplify this tool we ask all rental types to be accounted for in “Rent.”

Land Value asks for the yearly land value, as determined by tax forms or rental payment price.

Land Tax is the value at which your land is taxed. The template value represents the Ashe County Land tax, not in PUV.

Land Lease represents the length of the land lease for “Rent,” starting at Year 0. Even if this value is greater than 10, the **Land Value** output will account for a year’s worth of the lease up to Year 9.

Land Cost/Rotation is calculated by the formula: (*Land Value* * *Rotation Length* OR *Land Lease)*.

Land Tax/Year is calculated by the formula: (*Land Value* * *Land Tax*).

Labor Costs Worksheet:

Select if Labor Type Used allows the user to select whether “H2A,” “Local,” and/or “Owner” labor pools are used.

Average Cost/Hour is the average hourly wage per labor pool.

Employed H2A Workers/Year is used to sum *H2A Living Costs*.

Newly Hired H2A Workers is used to sum *H2A Application Fees.*

H2A Application Fees accounts for all fees involved with hiring a new H2A worker.

H2A Living Costs accounts for all living costs involved with 1 H2A worker annually.

Planting Worksheet:

Seedling Costs:

Seedling Type accounts for commonly planted Fraser fir seedling types.

Cost/Seedling accounts for the cost per ordered seedling, based on both NC Forest Service catalog and available online prices

Additional Seedling Expenditures accounts for any additional seedling costs, such as growing in an on-site transplant bed.

Cost/Acre is calculated by the formula: (*Cost/Seedling* + *Additional Seedling Expenditures*) * (*Planting Density* + Replants Year 2 + Replants Year 3).

Seedling Type Planted % accounts for the % of total seedlings planted for a particular *Seedling Type* and associated costs.

Additional Associated Costs accounts for any additional costs associated with seedling costs.

Cost/Rotation is calculated by the formula: (*Cost/Acre* * *Seedling Type Planted %*) + *Additional Associated Costs*

Replant Seedling Costs averages *Cost/Seedling* but it is assumed users would modify for a higher priced replant seedling if needed.

Planting Costs:

Initial Planting Type allows users to specify whether they plant by “Mechanical” or “Hand.”

Acre Planted By % accounts for the % of seedlings planted by *Initial Planting Type*.

Time/Seedling Planted averages the time taken to plant 1 seedling, as provided by time values published by Virginia Tech.

Labor Cost/Tree calculates the labor costs associated with planting 1 seedling by hourly wages.

Additional Associated Costs accounts for any additional costs associated with planting.

Cost/Acre is calculated by the formula: (*Cost/Tree* * *Acre Planted By %*) + *Additional Associated Costs.*

Replanting Year accounts for replanting costs in Years 2 and 3.

# of Trees Replanted accounts for trees replanted in Years 2 and 3. The template budget assumes all trees that experience Year 1 Mortality (calculated by *Planting Density* * *Mortality Rate Years 1-2*) are replanted, and no trees are replanted in Year 3.

Time/Seedling Replanted averages the time taken to replant 1 seedling, as provided by time values published by Virginia Tech.

Cost/Replant calculates the labor costs associated with planting 1 seedling by hourly wages.

Additional Associated Costs accounts for any additional costs associated with replanting.

Cost/Acre is calculated by the formula: (*# of Trees Replanted* * (*Replant Seedling Costs + Cost/Replant*)) + *Additional Associated Costs.*

Site Preparation Costs Worksheet:

Total Application Time accounts for the time required for mechanical site preparation, as assessed based on grower interviews and a publication by Ohio State.

Labor Cost/Acre calculates the labor costs based on *Total Application Time*.

Additional Associated Costs accounts for any additional costs associated with mechanical site preparation.

Cost/Acre is calculated by the formula: (*Labor Cost/Acre* + *Additional Associated Costs*).

Ground Cover Costs:

Ground Cover accounts for commonly planted ground covers, based on recommendations from North Carolina State Extension.

Cost/Unit accounts for costs of ground covers, based on online prices.

Unit Size (lbs) accounts for the unit size.

Rate (lbs/acre) accounts for the applied rate of ground cover, based on recommendations from North Carolina State Extension.

Applications/Year accounts for the number of applications per year, based on recommendations from North Carolina State Extension.

Time/Application accounts for the time taken to apply ground cover. We were unable to receive any time values by growers so this time is a rough estimate.

Additional Associated Costs accounts for any additional costs associated with ground cover.

Cost/Acre is calculated by the formula: (((*Cost/Unit* * *Rate*) / *Unit Size*) * *Applications/Year*) + (*Time/Application* * Averaged Labor Salary) + *Additional Associated Costs*

Treatment Year allows users to select which years the cost occurs in.

Fertilizer Costs Worksheet:

Fertilizer Name accounts for various fertilizers, based on recommendations from North Carolina State Extension.

N-P-K Ratio shows the listed ratio if growers are more familiar with fertilizers by this name.

Cost/Unit accounts for costs of fertilizers, based on online prices.

Unit Size (lbs) accounts for the unit size.

Rate/Application accounts for the recommended rate for 3-7 foot trees, based on recommendations from North Carolina State Extension.

Applications/Year accounts for the number of applications per year.

Time/Application accounts for the time taken to apply fertilizer. These times are averaged based on grower interviews and time values published by Virginia Tech.

Application Type changes *Time/Application*.

Additional Associated Costs accounts for any additional costs associated with fertilizer.

Cost/Acre is calculated by the formula: (((*Cost/Unit* * *Rate*) / *Unit Size*) * *Applications/Year*) + (*Time/Application* * Averaged Labor Salary) + *Additional Associated Costs*

Treatment Year allows users to select which years the cost occurs in.

Herbicide Costs Worksheet:

Herbicide Name accounts for various herbicides, based on recommendations from North Carolina State Extension.

Cost/Unit accounts for costs of herbicides, based on online prices.

Unit Size accounts for the unit size.

Rate/Application accounts for the labeled rate. All labeled rates with provided ranges select the higher rate.

Applications/Year accounts for the number of applications per year, based on grower interviews, labeled rates, and recommendations from North Carolina State Extension.

Time/Application accounts for the time taken to apply herbicide. These times are averaged based on grower interviews and time values published by Virginia Tech.

Application Type changes *Time/Application*.

Additional Associated Costs accounts for any additional costs associated with herbicide.

Cost/Acre is calculated by the formula: (((*Cost/Unit* * *Rate*) / *Unit Size*) * *Applications/Year*) + (*Time/Application* * Averaged Labor Salary) + *Additional Associated Costs*

Treatment Year allows users to select which years the cost occurs in.

Insecticide Costs Worksheet:

Insecticide Name accounts for various insecticides, based on recommendations from North Carolina State Extension.

Cost/Unit accounts for costs of insecticides, based on online prices.

Unit Size accounts for the unit size.

Rate/Application accounts for the labeled rate. All labeled rates with provided ranges select the higher rate.

Applications/Year accounts for the number of applications per year, based on grower interviews, labeled rates, and recommendations from North Carolina State Extension.

Time/Application accounts for the time taken to apply insecticide. These times are averaged based on grower interviews and time values published by Virginia Tech.

Application Type changes *Time/Application*.

Additional Associated Costs accounts for any additional costs associated with insecticide.

Cost/Acre is calculated by the formula: (((*Cost/Unit* * *Rate*) / *Unit Size*) * *Applications/Year*) + (*Time/Application* * Averaged Labor Salary) + *Additional Associated Costs*

Treatment Year allows users to select which years the cost occurs in.

Mowing Costs Worksheet:

Year accounts for the specific year the operation occurs.

Time/Application accounts for the time taken to mow an acre, as provided by time values published by Virginia Tech.

Applications/Year accounts for the number of times mowed per year.

Mower Type changes *Time/Application*.

Additional Associated Costs accounts for any additional costs associated with mowing, including diesel.

Cost/Year is calculated by the formula: (*Time/Application* * Averaged Labor Salary)

Deer Management Costs Worksheet:

Management Tool accounts for commonly used deer management tools, based on recommendations from North Carolina State Extension and interviews with growers.

Cost/Unit accounts for costs of management tools, based on online prices. Since some of these costs are not easily quantified, they are left blank.

Unit Size accounts for the unit size.

Rate/Application accounts for the recommended rate, provided either by North Carolina State Extension or estimations.

Applications/Year accounts for the number of applications per year, based on grower interviews, labeled rates, and recommendations from North Carolina State Extension.

Time/Application accounts for the time taken to apply complete management tools. These times are averaged based on grower interviews and time values published by Virginia Tech.

Additional Associated Costs accounts for any additional costs associated with deer management.

Cost/Acre is calculated by the formula: (((*Cost/Unit* * *Rate*) / *Unit Size*) * *Applications/Year*) + (*Time/Application* * Averaged Labor Salary) + *Additional Associated Costs*

Treatment Year allows users to select which years the cost occurs in.

Cone Management Costs Worksheet:

Cone Removal Method accounts for commonly used cone management techniques, based on recommendations from North Carolina State Extension and interviews with growers.

Spray Cost/Unit accounts for costs of sprays, based on online prices.

Unit Size accounts for the unit size.

Rate/Application accounts for the recommended rate, based on grower interviews, labeled rates, and recommendations from North Carolina State Extension.

Spray Solution/Tree accounts for the spray volume per tree, based on recommendations from North Carolina State Extension.

Time/Application/Tree accounts for the time taken for each cone management method, as provided by time values from North Carolina State Extension.

Cost/Tree is calculated by the formula: ((*Cost/Unit* * *Rate*) / *Unit Size* [converted to a per oz value by *Spray Solution/Tree*]) + (*Time/Application* * Averaged Labor Salary).

Acre Managed % accounts for the % of an acre that required cone management, and the calculated value is derived from taking the % of *Total Trees Harvested*.

Additional Associated Costs accounts for any additional costs associated with cone management.

Cost/Year is calculated by the formula: *Cost/Tree* (*Acre Managed* * *Total Trees Harvested*) + *Additional Associated Costs.*

Treatment Year allows users to select which years the cost occurs in.

Shearing Costs Worksheet:

Year accounts for the specific year the operation occurs.

Time/Tree accounts for the average time to shear each tree in seconds, based on grower interviews.

Labor Cost/Tree provides a per tree labor cost based on *Time/Tree* and Average Labor Salary.

Additional Associated Costs accounts for any additional costs associated with shearing.

Cost/Year is calculated by the formula: (*Labor Cost/Tree* * *Total Trees Harvested*) + *Additional Associated Costs*.

Harvesting Costs Worksheet:

Workers/Harvesting Crew accounts for the number of workers in a harvesting crew.

Trees Processed/Work Day accounts for the number of trees a harvesting crew harvests in a standard work day.

Hours/Work Day accounts for the labor hours a crew works.

Time/Tree calculates the harvest time per tree, based on *Trees Processed/Work Day* and *Hours/Work Day*.

Additional Harvesting Costs/Work Day accounts for any additional costs associated with harvesting per day.

Cost/Tree is calculated by the formula: ((*Time/Tree* * Average Labor Salary) * *Workers/Harvesting Crew*) + (*Additional Harvesting Costs/Work Day* / *Trees Processed/Work Day*).

Total Harvesting Costs [on the Interactive Decision Sheet] by year are calculated by the formula: *Cost/Tree* * (*Total % of Trees Harvested* by "Year" * *Total Trees Harvested*).

Loading/Shipping Costs Worksheet:

Workers/Loading + Shipping Crew accounts for the number of workers in a loading/shipping crew.

Trees Processed/Work Day accounts for the number of trees loaded/shipped from a crew in a standard work day.

Hours/Work Day accounts for the labor hours a crew works.

Time/Tree calculates the loading/shipping time per tree, based on *Trees Processed/Work Day* and *Hours/Work Day*.

Additional Loading/Shipping Costs/Work Day accounts for any additional costs associated with harvesting per day, which can include driving fuel.

Cost/Tree is calculated by the formula: ((*Time/Tree* * Average Labor Salary) * *Workers/Loading/Shipping Crew*) + (*Additional Loading/Shipping Costs/Work Day* / *Trees Processed/Work Day*).

Total Loading/Shipping Costs [on the Interactive Decision Sheet] by year are calculated by the formula: *Cost/Tree* * (*Total % of Trees Harvested* by "Year" * *Total Trees Harvested*).

Operational Costs Worksheet:

Associated Costs account for costs associated with each operational category.

Annual Costs/Operation accounts for various fixed cost categories for an entire operation, and where available prices were updated based on online values from the 2008 values.

Cost/Acre/Year divides each *Annual Costs/Operation* by *Total Acres of Farm (In All Crops)*.

Equipment Costs Worksheet:

Tools accounts for standard tools used by a mid-sized operation, based on online sources and grower interviews.

Cost estimates a standard cost based on online sources and grower interviews.

Amount/Operation accounts for the number of each tools owned by the operation.

Cost/Operation calculates the total price by multiplying *Cost* and *Amount/Operation*.

Total Tool Price sums all *Cost/Operation*.

Cost/Year [on the Interactive Decision Sheet] divides *Total Tool Price* by *Rotation Length*.

Miscellaneous Costs Worksheet:

Item allows the user to add any cost not otherwise accounted for in the enterprise budget.

Cost allows the user to enter the associated *Item* cost.

Labor (Hours) allows the user to enter the annual time required to complete the *Item*.

Cost/Year are calculated by the formula: *Cost* + (*Labor (Hours)* * Averaged Labor Salary).

Treatment Year allows users to select which years the cost occurs in.

APPENDIX II. WORKAROUND TO LENGTHEN ROTATION LENGTH FOR FUTURE ITERATIONS OF CT-EB

An initially unforeseen coding issue with Excel prevented the inclusion of longer rotation lengths. However, the problem is troubleshooted below in case future demand necessitates the need for longer rotations. This fix was not included in the initial version because of the lengthy nature of this revision.

The trouble stems from the fact that Excel picks up any digit in the “Treatment Year” cells as an individual year, even if the value is intended as a double digit value. For example, if a user indicated a cost occurred in Year 12, Excel would identify the cost as occurring in Years 1 and 2, not Year 12. An identified workaround would be to reassign each year value from numerical form to alphabetical form. To do so, all values assigned to each year throughout CT-EB, specifically in formulas and code associated with the Interactive Decision Sheet and User Worksheet tabs, would require this change from numeric to alphabetical form.