

SCALE OF PRODUCTION MATRIX

BEGINNING FARMER AND RANCHER
DEVELOPMENT PROGRAM GUIDE SERIES

DECEMBER 2017





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Suggested Citation

Cary, T. (2017). *Scale of production matrix*. East Lansing, MI: Michigan State University Center for Regional Food Systems. Retrieved from foodsystems.msu.edu/resources/scale-of-production-matrix

Acknowledgements

The author would like to thank Andrea Weiss of CRFS for communications leadership and Rachel Lee Cherry of Last Syllable Editorial for copy editing and proofreading.

This material is based upon work that is supported by the National Institute of Food and Agriculture, U.S. Department of Agriculture, under award number 2015-70017-22856



United States
Department of
Agriculture

National Institute
of Food and
Agriculture

About This Publication Series

This document is one of six resources in the Toolbox for Vegetable Farm Business Viability. The toolbox helps smaller scale vegetable farmers begin and progress along the path to business viability by assisting with planning, expenditures, and marketing. Toolbox resources are grouped into three categories:

- 1) Strategies for how to reach \$100,000 in sales: *Pathways to \$100K in Farm Sales* and *Pathways to \$100K Calculator*
- 2) Guidance on selecting a market that fits your farm: *Market Channel Selection Tool*
- 3) Suggestions for equipment and infrastructure investments for different scales (sizes) of farms: *Scale of Production Matrix* (information in table form and as a changeable Excel document), *Scale of Production Narrative* (a companion to the matrix with more details about different scales), *Scale of Production Optimization Tool* (generates suggestions based on your acreage, sales, etc.)

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➤ INTRODUCTION

This publication was created to be a helpful resource for beginning farmers when making decisions about infrastructure and equipment. We call it a “tool” in hopes that it will be, like other tools, something that helps you do your job as a farmer.

Purpose of the Scale of Production Tool

- Help farmers identify the possible infrastructure and key farm investments and costs they may be likely to expect at various scales of production
- Help farmers identify and prioritize key investments, based on investments that offer the best return. It could also help farmers who are thinking about increasing their scale or, to some extent, creating a leaner operation. The information is only presented here as increasing farm size but could also be useful for becoming leaner (e.g., more productive or efficient at the same scale).
- Expose farmers to some relative cost comparisons for better decision making

Decisions and Assumptions Made in Developing the Tool

- It is primarily designed for extensive (field-based, larger acreage), tractor-based, diverse, organic/sustainable, vegetable producers at the smaller scale in Michigan. This tool does not try to address the Biointensive, J.M. Fortier,

or highly hoophouse-focused or other highly intensive production approaches. It is hoophouse neutral; the tool does not assume that you should or shouldn't invest in season extension.

- The farm is business-oriented, income-generating, and on a path to reaching financial sustainability for the farmers (although using the *Scale of Production Matrix* will not guarantee financial stability), thereby assuming a trajectory of trying to reach at least \$125,000–\$150,000 in sales or \$30,000–\$50,000 in farmer income.
- Farm is on “average” (loamy) soil (neither pure clay or sand, etc.), avoiding some unique challenges of “pure” soils.
- Some choices are rated as “Y” (yes) that are perhaps not a great financial return on investment but have a good return on investment in quality of life and ease of work for the farmer and fellow workers.
- There is no infrastructure (buildings, well, greenhouse) or equipment on the farm at the start of the farm operation.
- Farmers tend to move from smaller to larger scale and/or from less to more mechanization over time and can often build upon the investments they have already made.

Limitations of the Tool

- This tool can only make generalizations as to if, when, or what investment in a tractor, equipment or infrastructure, or land is right for any given farm system, given the incredible variability of farm operations in goals, experience, and current conditions of any one farm.
- It cannot determine the right way for you to farm or the best or most ideal system for you.
- It cannot determine what is a good financial return on investment for all cases, what is just plain necessary, cost aside, or what is just worth it because life is better. Every farm's situation, at any given time, is different.
- It does not assume what water source is available to farmers. It assumes only that potable water for washing vegetables is an absolute necessity.
- It cannot predict how a farm is going to market its product, whether a farm is going to have to move most of its product off-farm for sale or sell it all on-farm, whether multiple large vehicles are needed, and so on.
- It cannot tell whether there is already infrastructure on the farm or if infrastructure must be built.

Layout of This Tool

The tool is organized based on farm sizes or scales, in acres, broken into five ranges:

- Less than 1 acre
- 1-2 acres
- 3-5 acres
- 6-10 acres
- 10-20 acres

These ranges were chosen in an attempt to highlight points of transition in production style that may occur as a farm scales up in size.

Companion Pieces

Further, the tool has three different but related parts. The first is this document, a set of tables that break the equipment and infrastructure investments into eight categories and show the likely investment needs going across the five farm size ranges. The second is an online, customizable Excel version of the *Scale of Production Matrix*, which can be found at msuorganicfarm.org/resources. The third is a narrative, which includes some detail about expectations of work at each scale, a profile of a farm at that scale and some detail of equipment and infrastructure a farm might have at that scale, and a summary cost table of these likely equipment and infrastructure investments.

➤ GUIDE TO LAYOUT

Index to the Scale of Production Matrix

There are 10 tables in the *Scale of Production Matrix* exploring the various areas of infrastructure and equipment investment in a working farm. The Summary Table aggregates the cost information for each scale detailed in Tables 1-8 (listed below). These detailed tables offer suggestions for potentially appropriate choices of equipment, infrastructure, or other investments for each scale. In Table 9, we explore some possible funding options for different scales. Farmers can also download an Excel version of this tool at msuorganicfarm.org/resources to modify as they choose and build their own draft infrastructure budget.

List of Tables

- **Summary Table**—Summarizes the total cost estimates by scale (size of farm) for Tables 1-8
- **1: Tractors**—Tractors, walking tractors, and cultivating tractors by scale (size of farm)
- **2: Tillage to Transplanting**—Implements and equipment for tillage, bed preparation, direct seeding, and transplanting
- **3: Cultivation**—Implements and equipment for cultivation
- **4: Harvest & Pest Management**—Implements and equipment for harvesting and pest management
- **5: Infrastructure**—Hoophouse, wash/pack area, and coolers
- **6: Water & Irrigation**
- **7: Sales, Delivery, & Mgmt. Tools**—Equipment, tools, and vehicle needs for sales, delivery, and business management
- **8: Land**—Cost considerations around land
- **9: Funding Sources**—Potential sources of financial assistance or funding for investment capital
- **References & Sources**—Sources and calculations for many costs and estimates used

Guide to the Layout of the Tables

Items, Descriptors, and Costs

The left side of each table lists the items appropriate for each table category with some very brief descriptors (“USED,” “2-row,” etc.). To the right is the likely range of costs for that item based on our research and an average cost. *Note:* There may be items missing from this list or items priced differently or named differently from what you would call them based on regional preferences. Consider this an opportunity to edit and improve the tool.

Scale (Size) Headings

Across the top are the different scales: “Less Than 1 Acre”, “1-2 Acres,” and so on. Each scale category then provides the options “Do You Need It?” “How Many?” and “Cost.”

Prioritizing Items at Different Scales

“Do you need it?” There are many answers to this question; here is a key to how we have answered it.

Yes (Y)—This assumes you need the item.

Example: In Table 1, look at the third item under Machinery & Equipment, “Walk-behind tractor,” and go across to “Less Than 1 Acre.” There is a “Y” in the “Do You Need It?” column, a 1 in the “How Many?” column, and a number for the average cost, \$850, in the “Cost” column.

Very Helpful (VH)—You may consider getting this item as it could be cost effective at this scale, but it isn’t critical.

Helpful (H)—This is an optional item. It could be helpful, but the benefit really doesn’t justify the cost at this point.

Maybe (M)—This is not really a cost issue but a strategy issue. For example, under Irrigation, you may find cheap overhead sprinklers handy and workable for your system if you have decent water pressure, or you might just use drip tape for everything, or you might use solid set irrigation.

No (N)—This is just not worth the investment for this scale, given the many other places you could spend the money.

Note: These are not rules but a guide, our suggestions, and you may answer these questions differently based on your farm, your experience, your preference, and so on.

How Many of This Item Do You Need?

We have made some estimates of how many of an item you might want to consider having, based on our research, but of course you may want or need more or less based on how you run your operation. Again, these numbers are just a starting point for evaluating and planning as you grow or change your operation. For some items, such as the in-row cultivation tools, we use per-row set costs so that you can look at building your own rather than purchasing an entire built three-point toolbar rig. With some of the infrastructure, such as cooler or hoophouse space, we provide a cost per square foot or cubic foot so that you can estimate based on different needs at different scales.

Cost

This is a product of the average cost for the item and the quantity needed. The total of all the costs for your scale is summed at the bottom of each individual page/table and in the Summary Table. These costs may not reflect items in your area or at a particular time of year.

Cost if Building on Previous Scale

Below the total cost in the bottom line on each table, there is a smaller number indicating the investment needed if you are building on the investments you have already made. (Example: In the Summary Table, the total investment cost for a 1-2 acre farm is \$37,235, but the cost if building on the previous scale is \$29,205 because you have already invested \$8,030 in the operation at less than 1 acre.)

Summary Table

ITEM	<1 ACRE COST	1-2 ACRES COST	3-5 ACRES COST	6-10 ACRES COST	10-20 ACRES COST
SEEDS & SEEDLINGS					
TOTAL	\$1,000	\$1,500	\$4,000	\$8,000	\$12,000
MACHINERY & EQUIPMENT					
Tillage machines	\$850	\$850	-	-	-
Full-size tractors	-	\$6,500	\$8,500	\$17,000	\$72,000
Cultivating tractors	-	-	-	\$4,000	\$17,000
Tillage implements	-	-	\$2,075	\$3,925	\$3,925
Bed preparation	-	\$1,500	\$1,500	\$3,100	\$7,600
Seeding implements	\$140	\$140	\$140	\$1,665	\$3,140
Planting/transplanting implements	-	-	-	\$4,500	\$7,500
Cultivation tools & implements: between-row	\$225	\$225	\$2,450	\$5,700	\$10,700
Cultivation tools & implements: in-row	\$100	\$200	\$760	\$4,060	\$6,450
Pest management	-	\$125	\$125	\$825	\$825
Harvesting implements	\$250	\$750	\$3,450	\$7,750	\$18,250
Construction, repair, & maintenance tools	\$500	\$1,000	\$1,000	\$1,000	\$2,000
TOTAL	\$2,065	\$11,290	\$20,000	\$53,525	\$149,390
INFRASTRUCTURE					
Hoophouses	-	\$5,215	\$7,157	\$15,646	\$22,330
Wash/pack station	\$1,260	\$2,470	\$5,220	\$19,470	\$27,220
Walk-in cooler	-	\$1,300	\$2,800	\$3,100	\$6,250
Water source	VARIABLES	\$5,000	\$5,000	\$5,000	\$8,750
Irrigation system	\$225	\$450	\$1,200	\$3,050	\$13,675
TOTAL	\$1,485	\$14,435	\$21,377	\$46,266	\$78,225
PRODUCE SALES & DELIVERY					
TOTAL	\$2,030	\$7,810	\$16,890	\$25,470	\$28,470
INFORMATION, FINANCIAL, & MEDIA MANAGEMENT					
TOTAL	\$1,700	\$1,700	\$1,700	\$1,700	\$1,700
RENT/MORTGAGE					
TOTAL	\$250	\$500	\$1,000	\$25,300	\$50,600
TOTAL	\$8,530	\$37,235	\$64,967	\$160,261	\$320,385
<i>Cost if building on previous scale investments</i>	-	\$29,205	\$27,732	\$95,294	\$157,074

Table 1. Tractors & Tillage

ITEM	Cost		Less Than 1 Acre			1-2 Acres			3-5 Acres			6-10 Acres			10-20 Acres			
	Range	Average	Do You Need It?	How Many?	Cost	Do You Need It?	How Many?	Cost	Do You Need It?	How Many?	Cost	Do You Need It?	How Many?	Cost	Do You Need It?	How Many?	Cost	
TILLAGE MACHINES																		
Tractors & Tillage (HP = horsepower)																		
			5-15 HP			15-30 HP			30-60 HP			120-160 HP			225-300 HP			
Rototiller [NEW]	\$300-\$700	\$500	N		\$-	N		\$-	Helpful		\$-	Helpful		\$-	N		\$-	
Walk-behind tractor (6-15 HP) [NEW] ²	\$1,500-\$4,500	\$3,000	N		\$-	Helpful		\$-	Very Helpful		\$-	Helpful		\$-	Helpful		\$-	
Walk-behind tractor (8-12 HP) [USED] ³	\$500-\$1,200	\$850	Y	1	\$850	Y	1	\$850	Very Helpful		\$-	Maybe		\$-	Maybe		\$-	
TOTAL					\$850			\$850			\$-			\$-			\$-	
FULL-SIZE TRACTORS																		
	Range	Average																
2WD (30-50+ HP) [USED]	\$2,500-\$7,500	\$5,000	Maybe		\$-	Very Helpful		\$-	N		\$-	N		\$-	N		\$-	
2WD (50-60 HP) [USED] ¹	\$5,000-\$8,000	\$6,500	N		\$-	Y	1	\$6,500	Y	1	\$6,500	Y	1	\$6,500	Y	1	\$6,500	
2WD (60-80 HP) [USED]	\$5,000-\$12,000	\$8,500	N		\$-	N		\$-	N		\$-	Y	1	\$8,500	Y	1	\$8,500	
4WD (40-50 HP) [USED; low hours] ²	\$16,000-\$35,000	\$26,500	N		\$-	N		\$-	N		\$-	N		\$-	Very Helpful		\$-	
4WD w/bucket (65 HP) [New] ⁴	\$45,000-\$55,000	\$55,000	N		\$-	N		\$-	N		\$-	Very Helpful		\$-	Y	1	\$55,000	
Tractor bucket attachment [USED/NEW]	-\$2,000/- \$6,000	\$2,000	N		\$-	N		\$-	Y	1	\$2,000	Y	1	\$2,000	Y	1	\$2,000	
TOTAL					\$-			\$6,500			\$8,500			\$17,000			\$72,000	
CULTIVATING TRACTORS																		
	Range	Average																
Farmall (A, B, Cub, 130 & 140) or Allis Chalmers G [USED]	\$1,000-\$7,000	\$4,000	N		\$-	N		\$-	Very Helpful		\$-	Y	1	\$4,000	Y	1	\$4,000	
Case 265 or IH 274 [USED]	\$4,000-\$12,000	\$8,000	N		\$-	N		\$-	Very Helpful		\$-	Very Helpful		\$-	Very Helpful		\$-	
John Deere 900 HC or Ford 1710 Offset [USED]	\$12,000-\$17,000	\$14,500	N		\$-	N		\$-	Very Helpful		\$-	Very Helpful		\$-	Maybe		\$-	
Tuff-bilt and other new manufacturers [NEW]	\$10,000-\$15,000	\$13,000	N		\$-	N		\$-	Very Helpful		\$-	Very Helpful		\$-	Y	1	\$13,000	
TOTAL					\$-			\$-			\$-			\$4,000			\$17,000	
TOTAL					\$850			\$7,350			\$8,500			\$21,000			\$89,000	
<i>Cost if building on previous scale investments</i>											\$6,500			\$1,150			\$12,500	\$68,000

1 If heavy soil, may need 60-80 HP.

2 Hours measure tractor usage, like miles on a car; 4-Wheel Drive (4WD) brings a significant increase in pulling power while still fitting with smaller-scale farm layout, whereas a much larger HP 2WD tractor can sometimes be mis-sized for your operation.

3 Walk-behind tractors offer a variety of attachments for cultivation, bed preparation, seeding and transplanting that may fit well into the cost structure of mid-sized farms at a more affordable cost range.

4 Some new imported tractors can range from -\$19,000- (2WD, 40 HP) to \$25,000-\$30,000 (4WD, 45-50 HP). Financing rates can be in the range of \$360/mo. for a 60 mo. loan on a \$20,000 tractor (\$21,600) and -\$700/mo. for a 60 mo. loan on a \$40,000 tractor (\$42,000).

Table 2. Tillage to Transplanting

ITEM	Cost		Less Than 1 Acre			1–2 Acres			3–5 Acres			6–10 Acres			10–20 Acres		
	Range	Average	Do You Need It?	How Many?	Cost	Do You Need It?	How Many?	Cost	Do You Need It?	How Many?	Cost	Do You Need It?	How Many?	Cost	Do You Need It?	How Many?	Cost
TILLAGE IMPLEMENTS																	
Moldboard plow [USED]	\$300–\$500	\$400	N		\$-	Very Helpful		\$-	Y	1	\$400	Maybe	1	\$-	Maybe	1	\$-
Chisel plow [USED]	\$500–\$1,500	\$1,000	N		\$-	N		\$-	Very Helpful		\$-	Y	1	\$1,000	Y	1	\$1,000
Disk harrow [USED]	\$800–\$1,500	\$1,200	N		\$-	N		\$-	Y	1	\$1,200	Y	1	\$1,200	Y	1	\$1,200
Field cultivator 6'–12' [USED]	\$500–\$2,000	\$1,250	N		\$-	N		\$-	Very Helpful		\$-	Y	1	\$1,250	Y	1	\$1,250
1-Row subsoiler [USED]	\$350–\$600	\$475	N		\$-	Helpful		\$-	Y	1	\$475	Y	1	\$475	Y	1	\$475
TOTAL					\$-			\$-			\$2,075			\$3,925			\$3,925
BED PREPARATION																	
Rotavator/rototiller [NEW]	\$1,300–\$1,600	\$1,500	N		\$-	Y	1	\$1,500	Y	1	\$1,500	Y	1	\$1,500	Y	1	\$1,500
Bed shaper/former [NEW]	\$1,000–\$3,000	\$1,500	N		\$-	N		\$-	N		\$-	N		\$-	Y	1	\$1,500
Plastic mulch layer [NEW]	\$1,300–\$1,800	\$1,600	N		\$-	N		\$-	Very Helpful		\$-	Y	1	\$1,600	Y	1	\$1,600
Field cultivator (80" Perfecta) [NEW]		\$3,000	N		\$-	N		\$-	N		\$-	Very Helpful		\$-	Y	1	\$3,000
TOTAL					\$-			\$1,500			\$1,500			\$3,100			\$7,600
SEEDING IMPLEMENTS																	
Low Cost/Durability: 1-row push seeder (Earthway) [NEW]	\$120–\$160	\$140	Y	1	\$140	Y	1	\$140	Y	1	\$140	Y	1	\$140	Y	1	\$140
Mid-range Cost/Durability: 1-row push seeder (Hoss) [NEW]		\$300	N		\$-	N		\$-	Very Helpful		\$-	Very Helpful		\$-	Maybe ⁶	1	\$-
High Cost/Durability: 1-row push seeder (Planet Jr, Jang) [NEW]	\$650–\$750	\$700	N		\$-	N		\$-	N		\$-	Very Helpful		\$-	Maybe ⁶	1	\$-
2/3-row push seeder & hitch kit (Jang) [NEW]		\$1,525	N		\$-	N		\$-	N		\$-	Y	1	\$1,525	Maybe ⁶	1	\$-
Tractor mount 3-pt 3-row seeders (Planet Jr, Jang) [NEW]	\$2,500–\$3,600	\$3,000	N		\$-	N		\$-	N		\$-	Very Helpful		\$-	Y	1	\$3,000
4-row pinpoint seeder [NEW]		\$250	N		\$-	N		\$-	N		\$-	Maybe ⁵		\$-	Maybe ⁵	1	\$-
TOTAL					\$140			\$140			\$140			\$1,665			\$3,140
PLANTING/TRANSPLANTING IMPLEMENTS																	
2-row 3-pt potato planter [USED]	\$750–\$2,200	\$1,500	N		\$-	N		\$-	Very Helpful	1	\$-	Y	1	\$1,500	Y	1	\$1,500
2-row 3-pt transplanter [NEW]	\$2,000–\$4,000	\$3,000	N		\$-	N		\$-	N		\$-	Very Helpful		\$-	Y	1	\$3,000
Water wheel transplanter (Multi-row) [NEW]	\$2,500–\$3,500	\$3,000	N		\$-	N		\$-	Very Helpful	1	\$-	Y	1	\$3,000	Y	1	\$3,000
TOTAL					\$-			\$-			\$-			\$4,500			\$7,500
TOTAL					\$140			\$1,640			\$3,715			\$13,190			\$22,165
<i>Cost if building on previous scale investments</i>								\$1,500			\$2,075			\$9,475			\$8,975

5 If doing intensive hoophouse seasonal greens production, a 4-row seeder may be a good fit for your farm system and worth the investment.
 6 Having more than one seeder at this scale is recommended. Having one of them be a more precise and more durable seeder will likely be worth the additional investment, especially if also adding the ability to plant 2, 3, or more rows at a time.

Table 3. Cultivation

ITEM	Cost		Less Than 1 Acre			1–2 Acres			3–5 Acres			6–10 Acres			10–20 Acres		
	Range	Average	Do You Need It?	How Many?	Cost	Do You Need It?	How Many?	Cost	Do You Need It?	How Many?	Cost	Do You Need It?	How Many?	Cost	Do You Need It?	How Many?	Cost
CULTIVATION TOOLS & IMPLEMENTS: BETWEEN-ROW																	
Wheelhoe [NEW]	\$150-\$400	\$225	Y	1	\$225	Y	1	\$225	Y	2	\$450	Y	2	\$450	Y	2	\$450
Field cultivator (sweeps, S-tine, C-tine) [USED]	\$500-\$1,500	\$1,000	N		\$-	N		\$-	Y	1	\$1,000	Y	2	\$2,000	Y	3	\$3,000
Basket weeder (for cultivating tractor) [NEW]	\$1,500-\$3,000	\$2,250	N		\$-	N		\$-	N		\$-	Y	1	\$2,250	Y	1	\$2,250
Multiple-head/row rotary tiller [NEW]	\$4,000-\$6,000	\$5,000	N		\$-	N		\$-	N		\$-	N		\$-	Maybe		\$-
3-pt toolbar/weeding frame, no attachments/tools [NEW] ⁷	\$750-\$1,250	\$1,000	N		\$-	Very Helpful		\$-	Y	1	\$1,000	Y	1	\$1,000	Y	1	\$1,000
Toolbar/weeding frame for walk-behind tractor [CUSTOM] ⁹	\$200-\$400	\$300	Maybe		\$-	Maybe		\$-	Maybe		\$-	N		\$-	N		\$-
Toolbar/weeding frame w/multiple tools/attachments (torsion, springhoe, Spyder, along with sweeps and/or C/S-tines) [NEW]	\$4,000	\$4,000	N		\$-	N		\$-	N		\$-	N		\$-	Y	1	\$4,000
Lilliston cultivator [USED]	\$300-\$800	\$500	N		\$-	N		\$-	Maybe		\$-	Maybe		\$-	Maybe		\$-
Brush weeder [NEW]	\$8,000	\$8,000	N		\$-	N		\$-	N		\$-	N		\$-	Maybe		\$-
Toolbar attachment: Spyder weeders [NEW] ⁸	\$170/row set ⁷	\$170	N		\$-	N		\$-	N		\$-	Maybe		\$-	Maybe		\$-
TOTAL					\$225			\$225			\$2,450			\$5,700			\$10,700
CULTIVATION TOOLS & IMPLEMENTS: IN-ROW																	
Hand hoes [NEW]	\$20-\$50	\$50	Y	2	\$100	Y	4	\$200	Y	8	\$400	Y	12	\$600	Y	12	\$600
Toolbar attachment: Finger weeder (\$600-\$800 per row set) [NEW] ⁸	\$1,800-\$2,400/ 3-row set	\$2,100	N		\$-	N		\$-	Helpful		\$-	Y	1	\$2,100	N		\$-
Toolbar attachment: torsion weeder [NEW] ⁸	\$80/row set	\$80	N		\$-	N		\$-	N		\$-	Maybe		\$-	Maybe		\$-
Toolbar attachment: springhoe weeder [NEW] ⁸	\$110/row set	\$110	N		\$-	N		\$-	N		\$-	Maybe		\$-	Maybe		\$-
Toolbar attachment: Flex tines [NEW] ⁸	\$120/row set	\$120	N		\$-	N		\$-	Y	3	\$360	Y	3	\$360	Maybe		\$-
3-pt Flextine weeder [NEW]	\$2,000-\$3,500	\$2,500	N		\$-	N		\$-	Helpful		\$-	Maybe	1	\$-	Y	1	\$2,500
Flame weeder: push type [NEW]	\$500-\$1,500	\$1,000	N		\$-	N		\$-	N		\$-	Y	1	\$1,000	N		\$-
Flame weeder: 3-pt mount [NEW]	\$1,200-\$5,500	\$3,350	N		\$-	N		\$-	N		\$-	Very Helpful	1	\$-	Y	1	\$3,350
Regi weeder [NEW]	\$4,500	\$4,500	N		\$-	N		\$-	N		\$-	Maybe		\$-	Maybe		\$-
TOTAL					\$100			\$200			\$760			\$4,060			\$6,450
TOTAL					\$325			\$425			\$3,210			\$9,760			\$17,150
<i>Cost if building on previous scale investments</i>								\$100			\$2,785			\$6,550			\$7,390

7 Toolbar/Cultivating Frame is needed to mount tools such as finger weeders, Spydres, cultivating disks, sweeps, flextines, and so on. Toolbars are extremely cost effective as they are a framework for attaching and experimenting with cultivating tools. You may find them used with or without tools (e.g., field cultivator) or have one built locally by a welder. This is an example from Buckey Tractor Co.: <http://www.buctraco.com/3%20Online%20Catalog/Toolbars.htm>

8 Must have or purchase a toolbar to mount these tools on. When used following between-row cultivation, provides cost-effective in-row weeding of established seedlings.

9 Walk-behind tractor-mounted toolbars for cultivation are a less expensive small-scale alternative to tractor- or cultivating tractor-mounted cultivation. Work with a local welder/metal fabricator and use online sources to design a frame and brackets that work for you.

Table 4. Harvest & Pest Management

ITEM	Cost		Less Than 1 Acre			1–2 Acres			3–5 Acres			6–10 Acres			10–20 Acres		
	Range	Average	Do You Need It?	How Many?	Cost	Do You Need It?	How Many?	Cost	Do You Need It?	How Many?	Cost	Do You Need It?	How Many?	Cost	Do You Need It?	How Many?	Cost
HARVESTING IMPLEMENTS																	
Hand harvesting equipment (knives, bins, forks, carts, etc.)	-\$500/acre	\$500	Y	0.5	\$250	Y	1.5	\$750	Y	4	\$2,000	Y	8	\$4,000	Y	16	\$8,000
Middlebuster (potatoes)	\$200–\$300	\$250	N		\$-	Very Helpful		\$-	Y	1	\$250	N		\$-	N		\$-
1-row potato harvester (ground drive)	\$500	\$500	N		\$-	N		\$-	Very Helpful		\$-	Y	1	\$500	N		\$-
2-row potato harvester (PTO/hydraulic drive)	\$4,000–\$9,000	\$6,500	N		\$-	N		\$-	N		\$-	Very Helpful		\$-	Y	1	\$6,500
Undercutter bar (carrots, beets, garlic, roots, leeks)	\$500–\$700	\$700	N		\$-	N		\$-	Y	1	\$700	Y	1	\$700	Y	1	\$700
Salad greens harvester: cordless drill operated	\$500–\$600	\$550	N		\$-	N		\$-	N		\$-	Y	1	\$550	Y	1	\$550
Salad greens harvester: self-propelled ¹⁰	\$8,000–\$12,000	\$10,000	N		\$-	N		\$-	N		\$-	N		\$-	Maybe		\$-
Hay wagon (for harvest & transport)	\$300–\$700	\$500	N		\$-	N		\$-	Y	1	\$500	Y	1	\$500	Y	2	\$1,000
Harvest wagon (hay wagon with roof & wash station)	\$1,000–\$2,000	\$1,500	N		\$-	N		\$-	N		\$-	Y	1	\$1,500	Y	1	\$1,500
Veg-Veyer ¹¹	\$10,000–\$20,000	\$15,000	N		\$-	N		\$-	N		\$-	N		\$-	Maybe ¹¹		\$-
TOTAL					\$250			\$750			\$3,450			\$7,750			\$18,250
PEST MANAGEMENT																	
Backpack sprayer	\$100–\$150	\$125	N		\$-	Y	1	\$125	Y	1	\$125	Y	1	\$125	Y	1	\$125
3-pt sprayer	\$400–\$1,000	\$700	N		\$-	N		\$-	N		\$-	Y	1	\$700	Y	1	\$700
TOTAL					\$-			\$125			\$125			\$825			\$825
TOTAL					\$250			\$875			\$3,575			\$8,575			\$19,075

Cost if building on previous scale investments

\$625

\$2,700

\$5,000

\$10,500

¹⁰ Expensive, but if salad mixes/microgreens are a really big part of your operation, this may be worth the investment.

¹¹ Also an expensive piece of equipment but can be an incredible time saver for harvesting large plantings of winter squash, cucumbers, summer squash, etc.

Table 5. Infrastructure

ITEM	Cost		Less Than 1 Acre			1–2 Acres			3–5 Acres			6–10 Acres			10–20 Acres		
	Range	Average	Do You Need It?	How Many?	Cost	Do You Need It?	How Many?	Cost	Do You Need It?	How Many?	Cost	Do You Need It?	How Many?	Cost	Do You Need It?	How Many?	Cost
HOOPHOUSES																	
GREENHOUSE (SQ. FT.)																	
			75–175 SQ. FT.			225–525 SQ. FT.			600–1,400 SQ. FT.			1,200–2,800 SQ. FT.			2,200–5,000 SQ. FT.		
Transplant production house (double layer plastic, transplant benches, heater, fans, roll-up sides)	\$3,500–\$6,000 (-\$5.4–\$7.4/sq. ft.)	\$6.40	Very Helpful		\$-	Y	768	\$4,915	Y	1,056	\$6,758	Y	2,240	\$14,336	Y	3,200	\$20,480
Heating, March–May [Natural gas @ \$1/CCF]	per sq. ft. cost	\$1	Maybe		\$-	Maybe		\$-	Maybe		\$-	Maybe		\$-	Maybe		\$-
Heating, March–May [Propane @ \$2.20/gal]	per sq. ft. cost	\$2	Maybe		\$-	Maybe		\$-	Maybe		\$-	Maybe		\$-	Maybe		\$-
Heat mat (warm-season seedlings) & controller		\$300	N		\$-	Y	1	\$300	Y	1.33	\$399	Y	1.7	\$510	Y	3.5	\$1,050
Vacuum seeder with 2 plates		\$800	N		\$-	N		\$-	Helpful		\$-	Y	1	\$800	Y	1	\$800
Low tunnels, -6’-8’ high (e.g., 14’ x 100’)	-\$1,000–\$2,000	\$1,500	Maybe		\$-	Maybe		\$-	Maybe		\$-	Maybe		\$-	Maybe		\$-
Mini tunnels, -2.5’-4’ high (e.g., 5’ x 100’)-Self-built	\$300–\$700	\$500	Maybe		\$-	Maybe		\$-	Maybe		\$-	Maybe		\$-	Maybe		\$-
30’ x 96’ Hoophouse (low end) [NEW]	\$7,000–\$15,000	\$11,000	Maybe		\$-	Maybe		\$-	Maybe		\$-	Maybe		\$-	Maybe		\$-
30’ x 96’ Hoophouse (high end) [NEW]	\$25,000–\$45,000	\$35,000	Maybe		\$-	Maybe		\$-	Maybe		\$-	Maybe		\$-	Maybe		\$-
30’ x 96’ Hoophouse [USED]	\$3,000–\$10,000	\$6,500	Maybe		\$-	Maybe		\$-	Maybe		\$-	Maybe		\$-	Maybe		\$-
TOTAL					\$-			\$5,215			\$7,157			\$15,646			\$22,330
WASH/PACK STATION																	
WASH/PACK STATION (SQ. FT.)																	
			50–125 SQ. FT.			150–375 SQ. FT.			400–1,000 SQ. FT.			800–2,000 SQ. FT.			1,500–3,750 SQ. FT.		
Small, open-air “garage in a box” or wood frame w/metal roof (\$5/sq. ft.)	\$800	\$800	Y	1	\$800	Y	2	\$1,600	Y	4	\$3,200	N		\$-	N		\$-
Large, enclosed (\$10–\$15/sq. ft.)		\$13	N		\$-	N		\$-	N		\$-	Y	1400	\$17,500	Y	2,000	\$25,000
Triple sink set (plastic/stainless)	\$200/\$500	\$250	Y	1	\$250	Y	2	\$500	Y	3	\$750	Y	2	\$500	Y	2	\$500
Large tubs or tanks (plastic or galvanized metal)	\$60–\$150	\$110	Y	1	\$110	Y	2	\$220	Y	2	\$220	Y	2	\$220	Y	2	\$220
Washing machine salad spinner ¹⁴	\$100–\$400	\$250	N		\$-	N	1	\$-	Y	1	\$250	Y	1	\$250	Y	1	\$250
Barrel washer [DIY/NEW]	\$500/\$2,000	\$500	N		\$-	N	1	\$-	Y	1	\$500	Y	1	\$500	Y	1	\$500
Wash line [NEW]	\$2,000–\$4,000	\$3,000	N		\$-	N	1	\$-	N		\$-	N		\$-	Maybe	1	\$-
Produce storage bins	\$2–\$8 ea.	\$5	Y	20	\$100	Y	30	\$150	Y	60	\$300	Y	100	\$500	Y	150	\$750
TOTAL					\$1,260			\$2,470			\$5,220			\$19,470			\$27,220
WALK-IN COOLER																	
COOLER SPACE (CU. FT.)																	
			> 50 CU. FT.			> 150 CU. FT.			> 400 CU. FT.			> 800 CU. FT.			> 1,500 CU. FT.		
CoolBot unit & air conditioner	\$300 + \$500	\$800	Very Helpful		\$-	Y	1	\$800	Y	1	\$800	Y	2	\$1,600	N		\$-
Condenser cooler unit	\$2,000–\$3,000	\$2,500	N		\$-	N		\$-	N		\$-	Maybe		\$-	Y	1	\$2,500
DIY room [R20] (\$2/cu. ft.)		\$2	N		\$-	Y	250	\$500	Y	600	\$1,200	Maybe		\$-	N		\$-
Refrigerated semi-trailer [R7] (\$1/cu. ft.)	-\$1,500	\$1,500	N		\$-	N		\$-	N		\$-	Y	1	\$1,500	N		\$-
Commercial cooler room [USED] (\$1/cu. ft.)		\$2	N		\$-	N		\$-	N		\$-	Maybe		\$-	Y	1,500	\$2,250
Cool, dry storage (cu. ft.)		\$1	Helpful		\$-	Very Helpful		\$-	Y	800	\$800	Y	1,000	\$1,000	Y	1,500	\$1,500
TOTAL					\$-			\$1,300			\$2,800			\$3,100			\$6,250
TOTAL					\$1,260			\$8,985			\$15,177			\$38,216			\$55,800

Cost if building on previous scale investments

\$8,025

\$6,192

\$23,039

\$17,584

12 Average Lower Michigan natural gas heating bill for a 16’ x 48’ hoophouse is about \$650–\$750 for March–May heating with a 60°F house (1,140 heating degree days).

13 Average Lower Michigan propane heating bill for a 16’ x 48’ hoophouse is about \$1,500–\$1,700 for March–May heating with a 60°F house (1,140 heating degree days).

14 Converting a washing machine into a salad spinner is an inexpensive investment of time. Here is a detailed example: <http://www.diychatroom.com/f47/maytag-washer-salad-spinner-conversion-469073/>

Table 7. Sales, Delivery, & Management Tools

PRODUCE SALES & DELIVERY ¹⁷	Cost		Less Than 1 Acre			1–2 Acres			3–5 Acres			6–10 Acres			10–20 Acres		
	Range	Cost	Do You Need It?	How Many?	Cost	Do You Need It?	How Many?	Cost	Do You Need It?	How Many?	Cost	Do You Need It?	How Many?	Cost	Do You Need It?	How Many?	Cost
SALES CAPACITY (\$)	\$5,000–\$25,000			\$15,000–\$50,000			\$40,000–\$120,000			\$80,000–\$240,000			\$150,000–\$450,000				
8' table	\$80–\$250	\$115	Y	2	\$230	Y	4	\$460	Y	6	\$690	Y	8	\$920	Y	8	\$920
Pop-up canopy (10' x 10')	\$99–\$500	\$300	Y	1	\$300	Y	2	\$600	Y	4	\$1,200	Y	6	\$1,800	Y	6	\$1,800
Produce scale	\$200–\$300	\$250	Y	1	\$250	Y	2	\$500	Y	4	\$1,000	Y	6	\$1,500	Y	6	\$1,500
Signage (2' x 6' banner)	\$200–\$300	\$250	Y	1	\$250	Y	1	\$250	Y	2	\$500	Y	3	\$750	Y	3	\$750
TOTAL					\$1,030			\$1,810			\$3,390			\$4,970			\$4,970
DELIVERY CAPACITY (CU. FT.)	45–100 CU. FT.			135–300 CU. FT.			360–800 CU. FT.			720–1,600 CU. FT.			1,350–3,000 CU. FT.				
Junker van or pickup	\$500–\$1,500	\$1,000	Y	1	\$1,000	N		\$-	N		\$-	N		\$-	N		\$-
Reliable van or pickup truck (2WD) [USED]	\$4,000–\$8,000	\$6,000	Very Helpful		\$-	Y	1	\$6,000	Y	2	\$12,000	Y	2	\$12,000	Very Helpful		\$-
Box truck (12'–14'); lease per month	\$800–\$1,200/mo.	\$1,000	N		\$-	Maybe		\$-	Y	1.5	\$1,500	Y	1.5	\$1,500	Y	4	\$4,000
Box truck (12'–14') [USED]	\$4,000–\$9,000	\$7,000	N		\$-	N		\$-	Very Helpful		\$-	Y	1	\$7,000	Y	1	\$7,000
Box Truck (20'–24') [USED]	\$10,000–\$15,000	\$12,500	N		\$-	N		\$-	N		\$-	Helpful		\$-	Y	1	\$12,500
6' x 10' CoolBot trailer [NEW]		\$3,900	N		\$-	Very Helpful		\$-	Very Helpful		\$-	Very Helpful		\$-	Very Helpful		\$-
TOTAL					\$2,030			\$7,810			\$16,890			\$25,470			\$28,470
INFORMATION, FINANCIAL, & MEDIA MANAGEMENT	Range	Average															
Computer with Microsoft Office/OpenOffice	\$500–\$1,000	\$750	Y	1	\$750	Y	1	\$750	Y	1	\$750	Y	1	\$750	Y	1	\$750
Financial management software	\$100–\$200	\$150	Y	1	\$150	Y	1	\$150	Y	1	\$150	Y	1	\$150	Y	1	\$150
Smartphone	\$600/year	\$600	Y	1	\$600	Y	1	\$600	Y	1	\$600	Y	1	\$600	Y	1	\$600
Website & domain name, website building/management	\$200/year	\$200	Y	1	\$200	Y	1	\$200	Y	1	\$200	Y	1	\$200	Y	1	\$200
TOTAL					\$1,700			\$1,700			\$1,700			\$1,700			\$1,700
TOTAL					\$4,760			\$11,320			\$21,980			\$32,140			\$35,140
<i>Cost if building on previous scale investments</i>								\$6,760			\$10,660			\$10,160			\$3,000

¹⁷ Note that delivery needs are entirely based on the type of sales operation. We are assuming a minimum of on-site sales with most produce needing to be sold off-site through CSA, farmers market, or wholesale delivery. If you sell entirely through an on-farm CSA pickup and farm stand, your delivery needs will be much less. In most cases, farms will need some level of produce delivery capacity.

Table 8. Land

RENT/MORTGAGE	Cost		Less Than 1 Acre			1-2 Acres			3-5 Acres			6-10 Acres			10-20 Acres		
	Range	Cost	Do You Need It?	How Many?	Cost	Do You Need It?	How Many?	Cost	Do You Need It?	How Many?	Cost	Do You Need It?	How Many?	Cost	Do You Need It?	How Many?	Cost
-150/acre rent (southern half of Lower Michigan), but smaller acreages will be higher ¹⁸	\$200-\$300	\$250	Y	1	\$250	Y	2	\$500	Y	4	\$1,000	N		\$-	N		\$-
Rent (northern half of Lower Michigan & UP)	\$40-\$80	\$60	Maybe		\$-	Maybe		\$-	Maybe		\$-	N		\$-	N		\$-
Purchase: 20% down on 10 acres, no house ¹⁹	\$50,000-\$120,000	\$17,000	N		\$-	N		\$-	Maybe		\$-	Y	1	\$17,000	Y	2	\$34,000
Purchase: Annual mortgage on 10 acres, no house	3.5% on \$83,000	\$8,300	N		\$-	N		\$-	Maybe		\$-	Y	1	\$8,300	Y	2	\$16,600
Purchase: 20% down on 10 acres + house ¹⁹	\$150,000-\$300,000	\$35,000	N		\$-	N		\$-	Maybe		\$-	Maybe		\$-	Maybe		\$-
Purchase: Annual mortgage on 10 acres + house (insurance & taxes)		\$13,000	N		\$-	N		\$-	Maybe		\$-	Maybe		\$-	Maybe		\$-
TOTAL					\$250			\$500			\$1,000			\$25,300			\$50,600
TOTAL					\$250			\$500			\$1,000			\$25,300			\$50,600
<i>Cost if building on previous scale investments</i>								\$250			\$500			\$24,300			\$25,300

18 Cost of rent/lease could be much more depending on infrastructure or other assets that might be part of the lease.

19 Here, "Range" shows the range of probable prices for the property and "Cost" shows the minimum down payment (20% down) on the average price (e.g., \$85,000 is the average between \$50,000-\$120,000; \$85,000 x 0.20 (20%) = \$17,000).

Table 9. Funding Sources

	Example(s)	Typical Range of Loan/Grant	Less Than 1 Acre	1-2 Acres	3-5 Acres	6-10 Acres	10-20 Acres
LOAN/FUNDING SOURCES-CONVENTIONAL							
			Do You Need It?	Do You Need It?	Do You Need It?	Do You Need It?	Do You Need It?
National commercial banks	Fifth Third Bank	\$20,000-\$50,000	N ²⁰	N ²⁰	Maybe	Maybe	Y
Local/regional banks	Lansing State Bank	\$5,000-\$25,000	Maybe ²⁰	Y	Y	Y	Y
Credit unions	Lake Michigan Credit Union	\$5,000-\$30,000	Maybe ²⁰	Y	Y	Y	Y
Federally regulated ag lenders	Greenstone FCS	\$10,000-\$50,000	Maybe ²¹	Maybe	Y	Y	Y
USDA-Farm Services Agency (FSA)	FSA	Up to \$500,000	Maybe ²²	Maybe	Y	Y	N
LOAN/FUNDING SOURCES-ALTERNATIVE-GENERAL							
Family & friend loans		\$100-\$10,000	Y	Y	Y	Y	Y
Community Development Financial Institutions (CDFIs)	Northern Initiatives, Capital Impact Partners, Opportunity Finance Network	\$10,000-\$50,000	Maybe ²³	Y	Y	Y	Y
Micro-loans	FSA, Local/regional bank	\$500-\$30,000	Y	Y	N	N	N
Multi-year Community Supported Agriculture (CSA) shares		based on CSA fees	N	Maybe ³⁰	Y ³⁰	Y ³⁰	Y ³⁰
Revenue-based financing or royalty financing ²⁴		\$5,000-\$50,000	Maybe ²⁵	Maybe ²⁵	Maybe ²⁵	Maybe ²⁵	Maybe ²⁵
Individual Development Accounts (IDAs)		\$2,000-\$10,000	Y ²¹	Maybe	N	N	N
STATEWIDE GRANT AND FEDERALLY FUNDED PROGRAMS							
NRCS Hoophouse Program		Up to -\$9,000?	Y ²⁶				
Michigan Good Food Fund (CDFI)		\$1,000 -\$50,000	Y ²⁵	Y	Y	Y	Maybe
LOAN/FUNDING SOURCES-ALTERNATIVE-CROWDFUNDING							
Donation crowdfunding	GoFundMe, Kickstarter, Indiegogo	Usually <\$100,000	Y	Y	Y	Y	Y
Reward crowdfunding	Fundable crowd program	Usually <\$100,000	Y	Y	Y	Y	Y
Debt crowdfunding	Prosper Lending Club	Usually >\$100,000	Maybe ²⁶	Maybe	Maybe	Y	Y
Equity crowdfunding	CircleUp, Crowdfunder, AngelList	Usually >\$100,000	N ²⁷	N	Maybe	Y	Y

20 Loan success is very dependent on perceived creditworthiness/credit history/credit score and assets to put up against loan as well as relationship with lender. The larger the bank, the less relationships may play a role.

21 Very familiar with ag. businesses, but depends on whether your need fits their loan types. May prioritize based on being a "small farmer" (<\$250,000 sales), "young farmer" (under 35), or "beginning farmer" (10 or fewer years farming).

22 Has a variety of loan opportunities but require a minimum 3 years farm management experience (<https://www.fsa.usda.gov/state-offices/Michigan/index>).

23 Entry-level farmers (1-3 years) may not be eligible for CDFI money; however, this source is worth contacting as decisions may be on a case-by-case basis.

24 Eligibility is based on income and requires setting aside funds in an escrow account (typically \$1,000-\$2,000) and a business plan. Potential sources: Michigan IDA Partnership (<http://michiganida.com>), Prosperity Now (formerly CFED; <https://prosperitynow.org/map>), and local sources such as Grand Rapids Opportunities for Women (GROW; <https://www.growbusiness.org/>)

25 Minimum of 2 years of operating history. More detailed criteria at <http://migooodfoodfund.org/eligibility>

26 Depends on amounts and profitability. Probably not a good fit for most small farms in the early stages unless loans are small or terms are flexible.

27 Depends on amounts and profitability. Probably not a good fit for most small farms.

28 Contact NRCS for eligibility criteria. Beginning farmer, small farm, young farmer, and minority farmer categories all come into play.

29 Only a viable option if business has high profit margins to meet revenue-based repayment.

30 Only viable if business is prepared to meet consistency and other commitments of CSA share agreements with customers. Farms must be in a stable and confident position for production, finance, and marketing.

31 Loan repayment is only a percentage of profit, not a set amount or based on gross sales.

➤ REFERENCES & SOURCES

Equipment & Implement Sources & Prices—General (below and also at <http://msuorganicfarm/resources> *)

Most costs in this resource are derived from online sources, research on Craigslist and other used farm equipment sources or purchases made by Groundswell Farm, MSU Student Organic Farm, or others as indicated.

Agrisupply: <http://www.agrisupply.com> (water tanks and much other equipment)

Buckeye Tractor Co.: <http://www.buctraco.com> (toolbars and attachments)

Carver Equipment: <http://www.carverequipment.com> (potato harvesters among much other equipment)

Earth Tools: <https://earthtoolsbcs.com> (Walk-behind tractors & accessories)

Forster Soil Management: <http://forstersoilmanagement.com/resources/small-scale-farm-equipment/>
(thoughtful list of small scale and innovative equipment)

Hillside Cultivator: <http://www.hillsidecultivator.com> (Cultivators, Eco-weeder, Tuff-Built tractors)

Josh Volk articles & images: <http://www.joshvolk.com> (equipment reviews, images and commentary)

Market Farm: <http://www.marketfarm.com> (Lely & Williams tools and lots of other equipment)

Roeters Farm Equipment: <http://www.roetersfarmequipment.com> (used equipment)

Small Farm Tools: <https://www.smallfarmtools.com> (variety of small farm equipment)

Wilsie Equipment Sales: <http://willsie.com> (new & used vegetable equipment)

Woodward Crossing: <http://shop.woodwardcrossingscountrybasics.com> (Toolbars)

FARM EQUIPMENT CLASSIFIEDS

<http://www.binghamfarmmachinery.com>, <https://www.tractorhouse.com>, <http://www.farmexchange.com>

OTHER RESOURCE LISTS

Growing For Market: <https://www.growingformarket.com/articles/Market-Farming-Success-Resources> (scroll down to “Chapter 4: Equipment & Tools” for a host of resources)

Small Farm Equipment (Jon Magee): <https://www.growingformarket.com/store/products/143>

Steel in the field resources: <http://www.sare.org/Learning-Center/Books/Steel-in-the-Field/Text-Version/The-Toolshed/Tool-Sources#15>

** A more comprehensive and up-to-date listing of equipment, implement & infrastructure sources & prices can be found at <http://msuorganicfarm/resources>*

Finger Weeder & Toolbar Costs

	PER PAIR/ ROW SET	1 ROW	3 ROW	
Weeders	\$400-\$500	\$450	\$1,350	http://suttonag.com/weeding_accessories.html
Brackets	\$90	\$90	\$270	http://suttonag.com/weeding_accessories.html
Lead (A blades, sweeps, sprint tines)	\$35-\$70	\$52.50	\$158	http://suttonag.com/weeding_accessories.html
Brackets	\$90	\$90	\$270	http://suttonag.com/weeding_accessories.html
Weeder set	—	\$683	\$2,048	—
Toolbar	\$350-\$500	\$425	\$425	http://www.buctraco.com/3%20Online%20Catalog/ToolbarsPL2.htm
Toolbar hitch	\$550-\$750	\$650	\$650	http://www.buctraco.com/3%20Online%20Catalog/ToolbarsPL1.htm
TOTAL		\$1,758	\$3,123	

Greenhouse Heaters

Greenhouse Heater Calculator: <http://www.greenhousecatalog.com/greenhouse-heater-calculator>

(Starting in March with estimated low temp of 10° F and needing to heat to 60°F on a 16' x 96' double poly film house) = 80,000 BTU

- Total sq. ft.-for Quonset type I just used (hoophouse width x 3.14/2) x length of hoophouse [Note you should plan for growth-you will need double the greenhouse if you double your acreage-Buy the heater you will most likely need in the future]-my result was 2,460 sq. ft.
- Max Inside Temp-set at 60°F-a good minimum for veggie transplants
- Min Outside Temp-used <http://www.usclimatedata.com/climate/holland/michigan/united-states/usmi0396> to determine the range of low temps in March (23°F for early March) and then subtracted 10°F from those numbers as a safety measure, resulting in 13°F.
- Heat Loss Factor-used the U-value of 0.7 for double poly film from this link: <http://bwgreenhouse.ca/R-valueU-value.html>
- Result = 2,460 sq. ft. x (60°F-13°F) x 0.7 (U-value) = -80,000 BTU needed

Estimating Minimum Nighttime Temp.

<http://www.usclimatedata.com/climate/holland/michigan/united-states/usmi0396>

(gives average maximum & minimum low temperatures for each day of the month-23°F avg. min. low temp in beginning of March) I subtracted 10° from that to get 13°.

Groundswell Community Farm Data

Groundswell Farm-16' x 96' greenhouse = 1,536 cu. Ft.; cultivated 7 acres; greenhouse space/acre = -220 cu. ft./ac.

Groundswell CSA share drop value = 90 shares x (\$550/22 weeks) x 1.3 (conversion to market value) = -\$3,000

Groundswell wash/pack water use = 2 lines with 3 x 10 gal + 3 x 20 gal + 30 gal each = 120 gal x 2 = 240 gal if triple sinks are changed twice each = 360 more gal = 600 gal + 150 gal tote = -750 gal.

Greenhouse Heater Costs & Output

BTU INPUT	BTU OUTPUT	COST	\$/1000 BTU	SOURCE
150k	120k	969	6.46	http://www.growerssolution.com/PROD/modine-pdp-gas-fired-heaters/MGHS
100k	80k	821	8.21	http://www.growerssolution.com/PROD/modine-hot-dawg-gas-heaters/hotdawg
30k	24k	327	10.9	http://www.growerssupply.com/farm/supplies/prod1:gs_greenhouse_heaters:pg109306_109308P.html
115k	92k	1322	11.5	http://www.bfgsupply.com/order-now/200/greenhouse-heaters/5923/adp-sep-115a-heater-nat-gas?f0=&f1=&f2=&p=1&ps=18

Heating Degree Day Calculator

	MAR	APR	MAY	TOTAL AVG. DEGREES/MO.	AVERAGE DAYS/MO.	HEATING DEGREE DAYS
Average Temp	36.5	48	57.5			
GH temp	60	60	60			
Temp difference (GH-Avg. Mo. Temp)	23.5	12	2.5	38	30	1140
Internal volume of tunnel (cu. ft.)	4823.04					

Heat cost calculator: <http://www.builditsolar.com/References/Calculators/HeatLoss/HeatLoss.htm>

(use only 1.3 as R value, 2,460 as ceiling area, 4,823 for internal volume, zero out all other surfaces, set natural gas and propane prices as found in your local)

Greenhouse Cost Estimating

WIDTH	LENGTH	COST	DELIVERY	END WALLS	PLASTIC	WIGGLE WIRE & CHANNEL (-\$1.55/FT.)	CONSTRUCTION TOTAL	HEATER	EXHAUST FANS	BENCHES, WIRING, ETC	TOTAL	SQ. FT.	\$/SQ. FT.	NATURAL GAS COST @ \$7/100CF	PROPANE COST @ \$2.20/GAL	SOURCE
16'	48'	\$2,421	free	\$250	\$275	\$233	\$3,179	\$1,000	\$650	\$300	\$5,129	768	\$6.68	0.88	2.08	http://www.greenhousemegastore.com
10'	48'	\$1,039	\$159	\$150	\$200	\$202	\$1,750	\$850	\$650	\$300	\$3,550	480	\$7.39	1.41	—	http://www.hoophouse.com/professional-series.html
16'	48'	\$1,275	\$200	\$250	\$275	\$233	\$2,233	\$1,000	\$650	\$300	\$4,183	768	\$5.45	0.88	—	http://www.amleo.com/cold-frame-hoop-house-1315x17-ga-steel-framing-16x48/p/CF1648/
16'	48'	\$2,544	\$200	228	\$275	\$233	\$3,480	\$1,000	\$650	\$300	\$5,430	768	\$7.07	0.88	—	http://www.growerssolution.com/PROD/16-ft-greenhouse-package-quonset/16ftquonsetpk

red = estimates

Water Needs Calculations

3630	cu. ft. for 1" water on 1 acre	1815	cu. ft. for 1/2" water on 1 acre
27225	gallons for 1" water per acre per week	13612.5	gallons for 1/2" water per acre per week
5	GPM	5	GPM
300	GPH	300	GPH
3000	GPD (10 hrs)	3000	GPD (10 hrs)
9.075	Days needed for 1" water	4.5375	Days needed for 1/2" water

Mahindra Tractor Data

MODEL	ENGINE HP	PTO HP	DRIVE	TRANSMISSION ³²	PRICE	CAB?
2545	45	39.2	4WD	Sync, shuttle w/ part synchronesh**	\$24,910	—
2555 [65B]	55	44.5	4WD	Sync, shuttle w/ part synchronesh**	~\$29,000	no cab
2565	65	50	4WD	Sync, shuttle w/ part synchronesh**	\$41,230	with cab
3550 HST	49	39.5	4WD	Hydrostatic	\$41,940	with cab
3550 PST	49	40	4WD	Powershuttle w/ full synchronesh**	\$40,690	with cab
4540	41	31	2WD	Sliding Mesh*	\$19,180	no cab
4550	48	38	2WD	Full constant mesh**	\$21,280	no cab
4550 4WD	48	38	4WD	Full constant mesh**	\$27,230	no cab
4570	70	61	2WD	Constant mesh w/ synchroshuttle**	\$27,250	no cab

Bucket: \$5,400-\$6,500

Tractor Loan Payments (estimate)

LOAN AMT	60 MO.	84 MO.
-\$20,000	\$360	\$265
-\$42,000	\$710	\$530

³² All tractors listed here, except 3550 hst are versions of the standard transmission

*Sliding Mesh—no synchronizers

**Constant mesh, full constant mesh, part synchronesh all utilize synchronizers to some degree

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