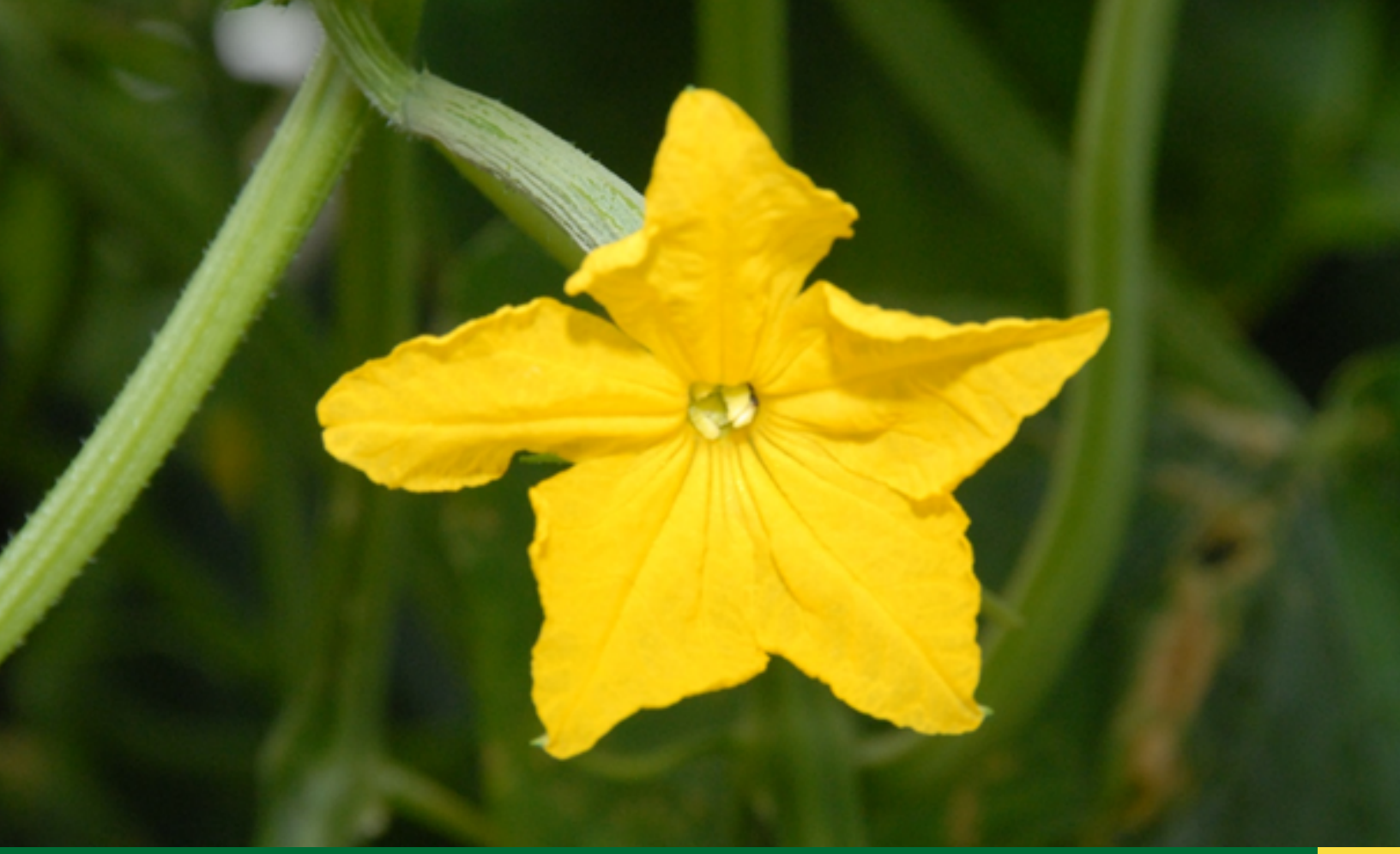


Greenhouse Planning Checklist

saskatchewan.ca/agriculture

Saskatchewan

Table of Contents

Introduction

Thinking about starting a greenhouse for yourself, as a group or for your community? To start and maintain a greenhouse, there are many aspects to consider. This checklist will guide you through the planning process. It consists of self-assessment questions with related information and tips covering key considerations when planning to purchase, build and ultimately operate a greenhouse.

Growing greenhouse plants is a combination of art and science. The art of growing is the ability to look at the plant, feel its leaves and consider its growth. The science is measuring, recording, looking at tests of tissue, soil and water. There is no right or wrong way between the art and science approach. This checklist will guide you on what areas to focus on and how to develop your greenhouse in the best way possible to suit your needs.

A greenhouse is a modified growing environment—that is, an environment not in an open field, whether farmed or natural—to help plants grow. The term "greenhouse" can mean different things to different people so it's important to define how the term will be used.

The different types of greenhouses used include:

- High tunnel or hoop house: usually have the least amount of structural material, no power and one layer of covering. Crops are often grown in or on the ground and are usually irrigated.
- Cold frame: often has the same structure as a greenhouse but may not have permanent heat or power. It may be a temporary building.
- Greenhouse: a permanent structure with a heating system, power and water.
- Inside of buildings: this includes shipping containers, warehouse buildings and vertical farms.

Appendix A at the end of this document illustrates typical greenhouse components and terminology.

This checklist is beneficial for making informed decisions about the kind of greenhouse that will be best suited for your project. The goal is to avoid costly changes. After completing this checklist, you will be able to:

- Complete a self-evaluation of where you are in the process of developing a greenhouse.
- Become aware of the various options when choosing a greenhouse project.
- Develop a planning process to identify what might require further attention and/or information.
- Have an outline of the project when communicating with individuals who are helping with the project or applying for funding.
- Identify next steps to move your project forward.
- Confirm that the information and project being considered are compatible before building a greenhouse.

Careful consideration of the costs, potential challenges and benefits is needed before choosing what style of greenhouse and construction materials will be the best fit as there are many designs and shapes to choose from.

There are a variety of Do-It-Yourself (DIY) greenhouse construction designs and resources available in printed publications and on the Internet. If you choose this option, look at where the information is coming from and the weather and light conditions compared to your location. "Northern greenhouse design" in the United States is very different from "Northern greenhouse design" in Western Canada; snow load, wind and light intensity all may differ.

If considering a manufactured greenhouse (e.g., a greenhouse package) try to find one from a prairie-based company that offers robust customer support. Ask about other greenhouses they may have supplied in your region. The most user friendly and durable design is the arch-style roofed, or "gothic arch" tubular steel frame with a double poly (plastic) cover. A bonus of purchasing a complete greenhouse "package" is that you know all the parts are compatible. A greenhouse package can range from a basic structure to one that has all the options, such as heating, cooling, lights, computer controls, etc. This will potentially save time retrofitting items, easily source additional or replacement materials, reduce shipping costs, and decrease building time, all of which are common challenges of a DIY project. If the greenhouse is funded through a grant or project, the package is usually a defined dollar amount and it is easier to track and record expenses.

Note: some sections of the checklist have an "Other" option and a textbox. Some description of what is meant would be useful for future reference or discussion. If you require more space, please attach paper(s) separately with the question number (e.g., "A1") to provide further information.

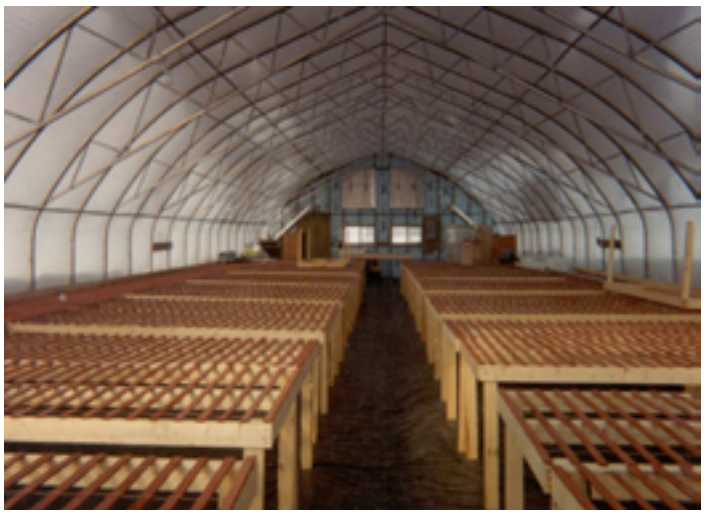
A. PURPOSE OF THE GREENHOUSE PROJECT

This is a very important place to start. A greenhouse is like a vehicle: it is a tool that has many uses, so you need to be clear on your vision.

For each question, check ALL answers that apply. If you check multiple boxes, it's helpful to provide a target percentage for the check (i.e., 40 per cent wholesale, 40 per cent Farmers Market, 20 per cent community).

A1. What is the purpose of the greenhouse?

- ☐ Business/economic development
- ☐ Education/training
- ☐ Community development (public enjoyment, ceremonies, traditional teachings, etc.)
- ☐ Job creation
- ☐ Food security through local food production
- ☐ Aesthetic improvement (flowers and shrubs)
- ☐ Environmental improvement (reclamation, wildlife habitat, etc.)
- ☐ I do not know
- ☐ Other:



Greenhouse with benches and an insulated north wall

A2. Who will be utilizing this greenhouse?

- ☐ A business and its employees
- ☐ An individual
- ☐ A community
- ☐ Specific user group (i.e. school)
- ☐ I do not know
- ☐ Other:

A3. What will the greenhouse be used to grow? Check all that may apply.

- ☐ Transplants (for supplying field production or other greenhouses)
- ☐ Vegetable vine crops (cucumbers, tomatoes etc.)
- ☐ Vegetable crops grown on the floor or a bench (short)—leafy greens, lettuce and herbs
- ☐ Landscaping plants, potted ornamentals, reclamation plants
- ☐ Water plants
- ☐ Tree seedlings
- ☐ Medicinal plants
- ☐ Ceremonial plants
- ☐ I do not know
- ☐ Other:

A4. What is the target market for these products? Check all that apply.

- ☐ Wholesale
- ☐ Retail stores
- ☐ Farm gate sales (direct to customers at the farm)
- ☐ Farmer's markets (direct to consumer)
- ☐ Reclamation or reforestation projects
- ☐ Boutique/specialty online store
- ☐ For local community or a select demographic (schools, elders, families with young children, etc.)
- ☐ I do not know
- ☐ Other:

B. BUSINESS PLANNING

The following questions do not replace business planning or feasibility analysis. Business planning and feasibility analysis are critical steps to achieving long-term economic sustainability for both non-profit and business-focused greenhouses. All goals must be incorporated into the business plan. Following initial construction and set-up costs, there will be ongoing fixed and variable operational costs of running a greenhouse. These could include standard overhead costs such as loan payments, land taxes, heat, electricity, water, delivery vehicle, fuel, tools, repairs and maintenance, cleaning, employee wages and associated costs, soil amendments (fertilizer), boxes and packaging supplies, pest and disease management, etc.

Greenhouses can have other primary uses other than production. These can be educational opportunities, providing free products for those who need it, employment training or rehabilitation work, or profit without outside funding, possibly all at the same time. These aspects can be incorporated into the business plan, even if the goal is not profit.

Greenhouse with tomato crop

B1. Which best describes the economic goal for your greenhouse?

- ☐ Cost-recovered (Break even, i.e., operating expenses are covered)
- ☐ Profit making
- ☐ Subsidized (i.e., financial losses are supplemented from other funding sources)
- ☐ I do not know
- ☐ Other:

B2. How will the costs of purchasing and constructing the greenhouse be covered?

- ☐ Savings
- ☐ Loans/Financing
- ☐ Grants
- ☐ Financial support from existing programs/other revenue streams
- ☐ I do not know
- ☐ Other:

B3. How will the costs of operating the greenhouse be covered?

- ☐ Savings
- ☐ Financial support from existing programs/Community fundraising
- ☐ Generated income
- ☐ Grants
- ☐ I do not know
- ☐ Other:

B4. Has the greenhouse project completed a business plan and feasibility study? Even a not-for-profit would benefit from the budgeting aspect.

- ☐ Yes, a business plan is prepared and includes a five-year cash flow forecast and marketing plan
- ☐ Yes, a rough business plan has been started, but needs further development
- ☐ No, a business plan has not been started
- ☐ I do not know
- ☐ Other:

C. STAFFING

The size of the growing area and type of plants grown will have an impact on staffing requirements. It is important to identify the roles of the management team early. The key to many greenhouse projects is to have someone leading this project. Is there someone with greenhouse experience or transferable skills? There are multiple other skills required, such as personnel management, financing and marketing. A greenhouse needs labour. This could be full time, seasonal, volunteer, or students depending on the scale of the operation.

There is a significant difference from field production or gardening. Some skills are transferable, but it is a challenge faced by many projects looking to start up. Developing and planning a human resource retaining strategy early in the planning process can set the groundwork for success. The next few questions will look at these labour requirements.

C1. Does this project have a champion or lead?

- ☐ Yes
- ☐ No
- ☐ I do not know

C2. Who is going to manage and work at the greenhouse?

- ☐ Experienced or trained grower (horticulturist)
- ☐ Existing staff person(s)
- ☐ Recruited volunteer(s) from the community
- ☐ Recruited employee(s) from the community
- ☐ Recruited employee(s) from outside the community
- ☐ I do not know

C3. Have you planned for the types of skills of the greenhouse business?

- ☐ Personal production
- ☐ Maintenance position(s)
- ☐ Delivery or driver to market
- ☐ Sales team (might include weekend work)
- ☐ Harvest and prep for market
- ☐ Weekend staff to water and temperature management
- ☐ I do not know

C4. Have you identified a need for staff training (management training, horticulture skills, greenhouse maintenance, sales and customer service, business management, food safety, pesticide applicator licence or other areas)?

- ☐ Yes
- ☐ No
- ☐ I do not know

Tip: Many greenhouse operations will require additional labour and management during certain times of the year. Because the greenhouse is not as weather dependent, working hours can be more flexible than field work; this may coincide well with school education or summer employment programs. Some greenhouse operations have also had success with creating job share and/or flexible hours. This could be in addition to finding technology that will save some labour hours/costs.

D. SITE SELECTION AND PREPARATION

Give careful thought to the best location for your greenhouse. Consider location of utilities (gas, power, water, cell service, sewer), driveway access, potential sources of shade (trees, buildings, etc.), direction the sun rises, slope of the area and areas requiring earthworks (levelling and site preparation for complimentary structures), prevailing wind, existing roads and other factors influencing the suitability of the site.

Consider factors such as the direction and strength of prevailing winds (winds that come from a predominant direction, depending on the season), shading from nearby buildings and trees, flooding/water table, market and road access. To minimize costs, look for a well-drained site with nearby or existing road access, utilities/services, sun exposure and requiring minimal leveling. Keep in mind that there is never a perfect site and compromises must be made.

D1. Location of the greenhouse

- ☐ Already own the land
- ☐ Have access to a location and know the cost
- ☐ Have a location in mind but do not know the cost
- ☐ I do not know
- ☐ Other:

Site preparations with slope for drainage

D2. Does the location have access to road and utilities?

- ☐ There is road access
- ☐ There is no road access
- ☐ There are utilities
- ☐ There are some or no utilities on site
- ☐ I don't know

D3. Have you been able to find the environmental (weather) conditions for your area?

- ☐ Yes
- ☐ No
- ☐ I do not know
- ☐ Some:

D4. Have you considered the environmental impact (water and nutrient recycling, waste disposal, pesticide run off handling, etc.) the greenhouse operation will have on the land?

- ☐ Yes
- ☐ No
- ☐ I do not know

D5. If there are challenges to the site that are not addressed, please list them.

E. UTILITIES

Depending on the style of the greenhouse and the growing season there may be requirements for gas, power, water, cell service and sewer on the site. It is good to know the capacity for your existing utilities. Contact SaskPower and SaskEnergy or propane utility companies about service availability or service locations early in the planning process. Also, work with a local electrician in the planning stage to avoid any surprises and potential delays. The requirement for the utilities varies on and this is to what is on-site that may be accessed.

In addition to basic (new) electric power and gas services that may need to be extended to the outside of the greenhouse, other services, such as water infrastructure (well, pump, pressure tank, piping, well-house, etc.), may also be required.

A site with no drainage can cause flooding and destroy a greenhouse/crops

Inside the greenhouse, gas fitting and water-proof electrical services need to be performed by a qualified professional. These costs can be substantial and should be determined at the time of pricing out the greenhouse structure, if not before.

E1. Utilities and services available:

- ☐ Yes, power service is nearby (i.e., less than 100 m from a power line/pole)
  - o Estimate of distance to electrical line/pole from the proposed greenhouse: _____
- ☐ There is no power service nearby
- ☐ Yes, natural gas service is nearby (i.e., less than 100 m)
  - o Estimate of distance to gas line from the proposed greenhouse: _____
- ☐ There is no natural gas service nearby
- ☐ Water sources is available on site:
- ☐ Alternative energy and heat are available for the project:
  - o Coal, propane, biomass
- ☐ Other:_____
- ☐ Cell service on site
- ☐ Telephone line is available
- ☐ Water sources available on site:
  - o Municipal
  - o Well
  - o Dugout
  - o Other: _____
- ☐ Sewer/grey water treatment
- ☐ I don't know

F. WATER

Water is very important and a lack of quality or quantity can be expensive to correct in the long run. Having a dependable source of quality water is critical. It is beneficial if it is potable (fit for human consumption) and is also required if the vegetables must be washed, or water gets on edible parts of the plant.

Note: potable does not mean it is suitable for plants. The water should also be tested for horticulture suitability. For example, some water may be safe to drink but may have a mineral content that is too high for good plant growth. Other issues with impurities are that they can clog watering equipment (irrigation nozzles) and filters over time. High salts in water can also affect plant growth.

Do not use pop bottles to send in water samples. Pop bottles may be contaminated with ingredients which may affect results (e.g., phosphoric acid, boron, microorganisms). Labs provide proper, clean and sanitized bottles for sampling.

A list of labs that provide water testing are available on saskatchewan.ca/agriculture. The Agriculture Knowledge Centre (1-866-457-2377) can also provide contact information for nearby labs.

Remember that in the long run it is less expensive to plan for expansion. To plan for layout, utility capacity from the start really helps expansion later. For example, the placement of utilities to match only the current structure might mean redoing the process if you expand.

F1. From the water quality test from the proposed site?

- ☐ The water is potable
- ☐ The water is not potable
- ☐ Is the water test acceptable for greenhouse production
- ☐ Is the water test not acceptable for greenhouse production
- ☐ I do not know

F2. If the water is not acceptable, is there a plan in place to deal with this?

- ☐ Yes, there enough quantity of usable water for the greenhouse
- ☐ No, there is not enough, then consider a water hauling and treatment costs
- ☐ I do not know

Tip: Water temperature is important. Some dugouts or well-water in the winter can be icy cold and shock plants. A holding tank may be needed to let it warm to room temperature before watering.

G. STRUCTURE

If you decide to go with a greenhouse supplier/manufacturer, they will be able to help with a greenhouse system that is best suited for your crop and local conditions. Height of the crop is a factor, as well as snow load and crop load on the structure, wind, rainfall for water runoff, production cropping temperature, outside temperature max and minimum and soil for structural support. Most of Saskatchewan is considered to have extreme weather conditions, making the greenhouse cost per square foot substantially higher than other areas because of the need for reinforced materials and other design requirements.

Greenhouse Construction (Assembly)

Building a basic greenhouse package can be a straightforward experience for people who have construction skills. Greenhouse manufacturing companies may offer assembly services. When building a greenhouse, it is important to take advantage of the sun. Greenhouses are built either north-south or east-west, depending on the crop. There is no light that will come from the north which is also the direction of colder winds. Due to these circumstances, the north wall can be a solid insulated wall to reduce heat loss.

The orientation of the greenhouse also helps in cooling, as air is brought in the cool north end and out the hot south end of the building. Depending on local building codes, you may also be required to have a set of engineered plans from the manufacturer. Check with your local authorities and a local building inspector for specific requirements.

When purchasing a greenhouse package, it is important to check if the end walls are included. They may not be, in order to allow flexibility in setup and design.

G1. Who will build the greenhouse? There may be multiple answers.

- ☐ Greenhouse manufacturer
- ☐ Local contractor
- ☐ Volunteers
- ☐ Community volunteers
- ☐ I do not know
- ☐ Other:

G2. In the long term, who will maintain the greenhouse structure?

- ☐ Greenhouse manufacturer
- ☐ Local contractor/works department
- ☐ Volunteers
- ☐ Community association
- ☐ I do not know

Tip: Poly (plastic) coverings are affected by temperature and wind. Minimum wind is critical when you are putting it on, as it can easily be blown away. If poly is put on when it is too cold, it stretches when it warms up and flaps in the wind, shortening the lifespan of the product. If it is put on when it is too hot the plastic shrinks and might be too tight. Talk to your supplier about the product you selected.

H. STRUCTURE CONSIDERATIONS

H1. Which main environmental conditions could negatively impact your greenhouse structure over the course of the year?

- ☐ Snow loads
- ☐ Rain
- ☐ Flooding
- ☐ Wind
- ☐ Hail
- ☐ Extreme heat and or cold
- ☐ I do not know
- ☐ Dry conditions
- ☐ Other:

H2. Which type of crop are you considering? The crop could affect the style and design of greenhouse.

- ☐ Vine crops: tomatoes and cucumbers for example are often supported from the structure
- ☐ Crops grown on benches
- ☐ Crops that are short and/or grow on the floor
- ☐ Crops are grown in the soil in the greenhouse
- ☐ I do not know
- ☐ Other:

H3. What is the approximant size of structure you are considering?

- ☐ Small e.g., 10' x 20' (hobby, personal garden scale); hard to manage as they heat and cool down fast
- ☐ Medium e.g., 30'x 50' (community garden starter, small retail sales)
- ☐ Large e.g., 30'x 100'+ (commercial business, industrial)
- ☐ Multiple connected structures—e.g., 100' by 100' (commercial business, industrial)
- ☐ The size is:
- ☐ I do not know

H4. What style of greenhouse are you considering?

- ☐ Arch-style roof (gothic-style)
- ☐ Venlo-style
- ☐ Lean-to style
- ☐ Round
- ☐ Solar
- ☐ Post and rafter
- ☐ Modified shipping container
- ☐ Indoor\vertical
- ☐ Existing building
- ☐ I do not know

H5. What kind of floor is planned for the greenhouse?

- ☐ Soil (for growing in)
- ☐ Sand
- ☐ Concrete
- ☐ Landscape cloth
- ☐ I do not know
- ☐ Other:

The type of flooring inside of the greenhouse is relevant for various reasons. Having a level or slight slop for irrigation lines is important. Well-drained and weed-free floor options range from landscape fabric to concrete. Putting down a good quality landscape fabric on top of settled gravel increases drainage and cuts down on maintenance, as it provides the ability to clean the floor and remove sources of disease, insects and weeds.

Greenhouse collapsed by snow load

If the crop will be grown in the soil inside the greenhouse, it is important to check the quality (nutrients) and makeup (clay, loam, sand, organic material) of the soil. It is easier to amend the soil to what the crops likes, before building. Note: Do not use a long-lasting herbicide before building the greenhouse on that area.

I. LIGHTING, HEATING AND COOLING EQUIPMENT

Much of crop health is determined by light and temperature. There are many variables and solutions available so this will only be an introduction to this topic.

Saskatchewan summer heat can easily turn into extreme heat in a greenhouse, so cooling the greenhouse environment is very important for optimum production and plant health. Each crop has a maximum temperature at which it stops growing. More importantly, the plants are likely to suffer irreparable damage if the temperatures exceeds these values.

Airflow and temperature control are also critical for growth and health of the plants. Disease management and to some degree insect populations are impacted by temperature and humidity as well. A high tunnel (no heat or power) will help extend the growing season of field production. Beyond that, a greenhouse in operation from late fall to early spring will not get enough heat and light for adequate plant growth for most crops. These often have roll-up sides or vents used to create a natural draft to reduce temperatures.

One way to get airflow into the greenhouse is by designing the greenhouse to have "roll-ups" or vents on the opposite sides of the structure (see Appendix A). In this type of structure, the bottom five feet or so of the side walls roll up. To help reduce insect pests, one can put a fine mesh screen covering that area to prevent insects from entering; there will be a slight reduction of airflow, but the greater reduction of insects is usually worth it.

Some designs vent the hot air through the roof. Hot air naturally rises and vents out the top, thus pulling cooler ground level air in as part of natural convection. These openings are also often screened. With the use of a greenhouse fan or fan with cooling pads, they move air as required. The fans can be set up to push air into the greenhouse or pull air out of the greenhouse. In most cases they move air from the cold side of the greenhouse to the hot side (north to south).

When the outside temperatures are extremely hot, the natural air-cooling systems might not be enough as the cooling air is still above the crop's desired temperatures. Greenhouses do have a few other options to reduce heat, such as the use of a shade cloth covering, a special whitewash designed for greenhouses (do not use paint), energy curtains or cooling pads. The main function of greenhouse curtains is shading and energy savings, including cooling in the summer or holding in heat in the winter.

Proper climate control is the result of integrating various systems and no single addition to your greenhouse should be addressed in isolation.

Supplemental lighting and heating will be required if the plan is to extend the production season past these points. Careful consideration should be given to the increased value of the product (higher price) in relation to the extra cost of heating and lighting. There is a lot of new information and research on lighting in greenhouses, and it needs to be customized for your operation.

Automation of the control equipment can aid in the management of the growing environment (heat, lighting, irrigation). The systems can be semi- or fully automated with set points and a warning system if conditions go beyond the set points. The additional up-front cost of automation should be weighed against staff time (including after business hours) and reduced crop risk is also a consideration. There are also ways to remotely control or monitor the greenhouse environment if Internet or cellular coverage is available.

I1. Will the greenhouse have a supplemental growing light installed?

- ☐ Yes, the number of weeks/months of the year lighting is needed has been selected (identified)
- ☐ No, the number of weeks/months of the year lighting is needed has not been worked out
- ☐ Yes, the lighting system type has been selected (HID, Sodium, LED, etc.)
- ☐ No, the light system has not been selected
- ☐ No lighting system is required
- ☐ I do not know

I2. What kind of temperature regulating equipment will be required?

- ☐ Heating
- ☐ Ventilation
- ☐ Shading/cooling (shade cloth, energy curtains, cooling pads)
- ☐ I do not know
- ☐ Other:

I3. What kind of venting control is being considered?

- ☐ Manual (roll-up sides or open vents by hand)
- ☐ Thermostat controlled fans (simple on/off)
- ☐ Automated opening (computer that may include a weather station or off-site capability)
- ☐ I do not know
- ☐ Other:

I4. What kind of heating system do you want to use?

- ☐ Electric heater
- ☐ Natural gas/propane furnace
- ☐ Biomass/wood/coal boiler/geothermal
- ☐ Sunlight/passive solar/natural heat
- ☐ I do not know
- ☐ Other:

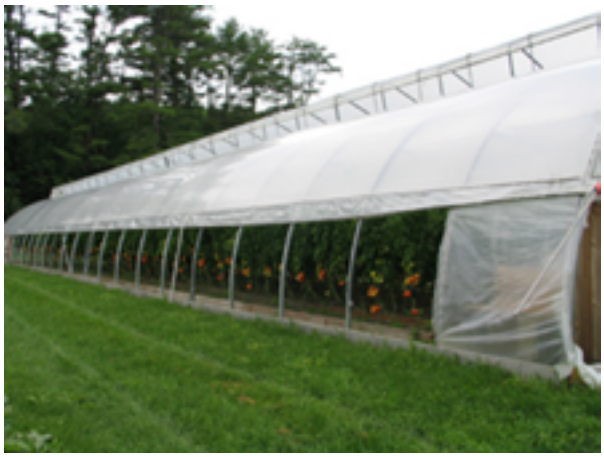
I5. What irrigation equipment is being considered?

- ☐ Hose and watering wands
- ☐ Flood systems, booms, floating raft
- ☐ Drip tape or drip system
- ☐ Sprinklers
- ☐ I do not know
- ☐ Other:

Tip: An automatic drip or sprinkler system that utilizes irrigation timers can significantly decrease employee hours required to water plants, reduce fertilizer costs, reduce environmental impact and increase the uniformity of the moisture in the crop.

Tip: The delivery of heat can also have an impact on the crop. Heating lines in the ground or on the bench can result in a boost in plant root development. Forced air systems increase air movement in the greenhouse and can help reduce diseases.

Environment control in a modified growing environment system is all-inclusive and must be provided. Check the parameters of the unit as they are still affected by weather conditions, the supply of utilities, heating and cooling, lighting, water, growing media, etc. This checklist still applies in these situations. Even if growing media are built into the unit, it is important to identify and understand its capacity. There are many companies modifying shipping containers in the market and the province has had commercial vertical farms in production for a few years, as well as new and repurposed buildings used for indoor plant production across the province.



Greenhouse with side and roof vents

J. MODIFIED GROWING SPACE

There is increased interest on growing inside buildings or in a modified shipping container. When growing inside a building, it is important to have a plan for dealing with high humidity and possible mold issues. These are usually intensely technology-based productions (some come with a growing system with over 18 sensors).

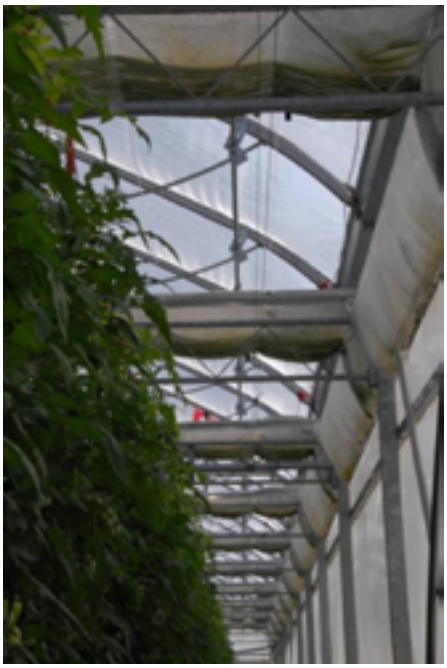
Take time to plan for ongoing consulting costs, repair/replacement costs and down time, having staff on site trained in troubleshooting when systems go down and personnel to manage and understand the specific parameters related to heat and moisture inside the greenhouse. When looking at the production specs of these modified containers, some information may not be readily available on their websites.

J1. Has the modified shipping container suppliers provided the following information?

- ☐ Yes, the production space information is provided
- ☐ Yes, the entire growing system is in the container
- ☐ Yes, the crop access and walkways are identified
- ☐ Yes, the crop height and/or vertical shelves have been considered
- ☐ They have not provided information
- ☐ I do not know

J2. Does your site meet the following requirements?

- ☐ Yes, there is stable WiFi access or ground line for systems to be equipped with 24/7 streaming and/or monitoring
- ☐ Yes, the container designed for application in a wide range of climates; the insulation will still have a maximum and minimum outside operating temperature
- ☐ None of the above criteria are met
- ☐ I do not know



Energy curtain opening up

J3. Modified growing environment or indoor production,

- ☐ The walls are built and sealed in such a way to avoid mold issues
- ☐ The water lines are assessable if there is a break or leak and a plan to deal with it
- ☐ There is a safety plan in place for vertical farming that requires employees to use ladders or lifts
- ☐ I do not know

K. SOIL, GROWING MEDIUM AND AMENDMENTS

There are too many options of what plants grow in to be answered in a few questions.
This section will focus on information awareness. Media is an industry term for what material the plant grows in—such as soil, dirt, coco fiber, or peatmoss—to help identify and/or describe some of the systems available. With soil, soilless media, or water, monitoring nutrient levels and having a fertilizer program are necessary to help reproduce results in following years. The plants consume nutrients and, depending on their stage of life, require different amounts at different times. Monitoring and recording these will help fine-tune the nutrients provided.

Soilless

Soilless media includes, but is not limited to, potting mix (vermiculite, perlite and peatmoss), rockwool and coco fiber. Soilless media might come with items such as beneficial bacterial, pH adjustment, wetting agent, or a small fertilizer boost. Soilless media is designed to have nutrients provided during the production cycle; these are usually weed- and insect- free with a known capillary action (how well it drains and air capacity).

Soil

Soil or dirt refers to naturally found material that might include clay, loam, sand and organic material. Often these are mixed with manure, compost, worm castings, bone meal, alfalfa pellets, mulch, etc. for nutrients. These are mainly prepared before planting. Soil and dirt may contain weed seeds and insects (if it has not been heat sterilized). Soil nutrients, capillary action (how well it drains) or air holding capacity are unknown without testing and vary from batch to batch.

Water

Some crops are grown only with water that contains nutrients and oxygen. The difference in these systems is how much water is used and whether they are deep water culture hydroponic systems, raft systems, pipe systems, aeroponics, etc.

There are certified organic greenhouses that have guidelines that must be followed. Because each certification body can be slightly different, please consult the Organic Certification Agencies directly for that information. In Saskatchewan there are three Organic Certification Groups: Ecocert Canada, Pro-Cert Organic Systems and TCO-Cert.

In Canada, most crops grown using hydroponic systems do not qualify as organically grown.

K1. What growing mediums are you considering growing plants in?

- ☐ Peat moss
- ☐ Purchased growing mix
- ☐ Coco fiber
- ☐ Rock wool
- ☐ Directly in the ground
- ☐ Soil or dirt
- ☐ Water only systems/aquaponics
- ☐ I do not know
- ☐ Other(s):

Tip: If sourcing composted manure from local farms, be sure to talk to the operator/owner and ask if they use herbicides or other pesticides in their operation. Some herbicides may persist in the straw (bedding) and be detrimental to plant growth in the greenhouse.

L. WHAT TO GROW AND WHERE WILL IT GO

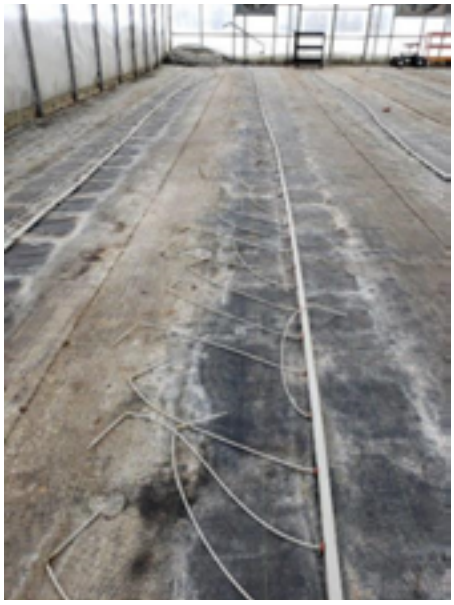
If growing edible products (vegetables, herbs)

Greenhouses can grow a very large amount of food in small spaces and in impressive timeframes. This document is not recommending any specific crops. Greenhouses are a tool to produce a crop, with close to optimum growing conditions and a reduced environmental risk.

Consider your competition if any, local diet, need for specific crops and price point. The best concept incorporates the value chain from food production to consumption. Can you supply at times of the year that other sources cannot? For example, higher profit margins may be found in early spring and the fall season for crops that cannot be grown without a greenhouse.

L1. Have you identified what will be grown in the greenhouse?

- ☐ Yes, we did a market analysis
- ☐ The plan is to grow many crops and develop the market
- ☐ The crop is not the focus of the greenhouse
- ☐ We will grow a couple crops that are easy to grow and we know people like them
- ☐ These plants will be used for ceremony and other traditional purposes
- ☐ There is value-added or processing
- ☐ This is still being developed
- ☐ I do not know



Drip irrigation for plants in a container

L2. What can the greenhouse provide to the restaurants?

- ☐ Yes, we did a market analysis or there is a plan for the product
- ☐ Yes, there is a use for culls (misshaped) product
- ☐ Yes, there is a value-added product (prepared products such as jams, pickles, etc.)
- ☐ I do not know

L3. What is the marketing plan being considering? Even if the goal of the greenhouse is not the sale of the product, these questions should still be considered.

- ☐ Online ordering with delivery to consumer
- ☐ Farm gate sales (consumers come to the greenhouse)
- ☐ Farmers market/in a store/other sales locations (may require a business licence)
- ☐ Community Supported Agriculture (CSA—a direct marketing channel by which farmers sell shares or subscriptions for farm products to consumer)
- ☐ Product is sold wholesale
- ☐ I do not know

Crop grown inside repurposed building

L4. If the local farmers market is part of the plan, have you done any of the following?

- ☐ Reviewed the rules of that farmers market
- ☐ Met with the farmers market and they agreed you can sell product there
- ☐ Accounted for when it operates and what kind of produce/goods you can sell
- ☐ Accounted for the table rental price, transportation and workers' time
- ☐ Developed signage and packaging
- ☐ I do not know

L5. Is produce for members in the community for little or no charge?

- ☐ Community has an existing "Good Food Box*" system
- ☐ Community has an existing Food Bank and they have agreed to it
- ☐ Elders and members in need
- ☐ I do not know

* A community-based food distribution program as an alternative way to get fresh produce. (https://www.reachinregina.ca/programs/good-food-box)

L6. Are there opportunities with regular local community meals (e.g., luncheons, feasts or meals during community activities or other events)?

- ☐ Yes
- ☐ No
- ☐ I do not know

L7. Does your community currently have a community garden?

- ☐ Yes, this will be part of or complement the project
- ☐ Yes, although not related to this project
- ☐ It is also in the planning stage
- ☐ No
- ☐ I do not know

L8. Has food safety been addressed?

- ☐ There is a complete food safety plan in place
- ☐ Food safety training is being set up or planned for
- ☐ I do not know

It is also important to remember that greenhouse products often receive a premium price. For example, a greenhouse tomato sells for more money than a field grown tomato for several reasons:

- They are vine ripened, so they have a sweeter taste (a results of the acids having time to change to sugars in the ripening process) while field tomatoes that are shipped large distances are picked green and ripened by gas. You can tell greenhouse tomatoes by their green seeds, red fruit and strong acid levels.
- The greenhouse variety is selected for taste rather than shipping durability (thinner skin, etc.).
- Greenhouse varieties are usually indeterminate (vine) plants and field are determent (bush). The vine crops keep producing ripe tomatoes over months where determent tomatoes all ripen on the plant at about the same time.

M. MARKETS

Other aspects some consumers are looking for is produce that is local, is organic certified, no pesticides used, is food safety certified, has an environmental farm plan, is from a greenhouse, is from a producer with a good reputation or organization brand, and uses certain labeling and packaging (e.g., is recyclable).

If growing non-edible products (flower/bedding plants, woody plants, transplants, etc.):

M1. What is the market for these products?

- ☐ Contracts: example, contracts such are reforestation or reclamation projects
- ☐ Transplants: example, vegetable seedling for field production or strawberry plants
- ☐ Bedding plants, potted plants, hanging baskets.
- ☐ Community beatification projects; flower beds and flower containers for urban location
- ☐ Direct to consumer
- ☐ Wholesale—supply a garden centre
- ☐ Medical
- ☐ Spiritual, ceremonial, etc.
- ☐ I do not know
- ☐ Other:

N. Produce handling, Storage, Transportation and Regulation

Food safety is important to all of us. Safe food production and processing needs a seed-to-plate approach. It is good to be aware of the food safety protocols in the planning stage of setting up a greenhouse.

Producers are responsible for complying with all relevant federal, provincial and municipal legislation and bylaws that deal with the production and sale of food.

Regarding marketing and sales, it is a good idea to look at bags/containers (with labels). Barcodes may be required if selling to retailers. Products sold in retail without labels might be sold as field produce and the higher value would not be captured. Labels are also important for food traceability in food safety. There are regulations and guidelines on this as well. More information is available from the Canadian Food Inspection Agency (CFIA).

CanadaGAP® is a volunteer food safety program for companies that produce, handle and broker sales of fruits and vegetables. The program has been fully recognized by the Government of Canada and is designed to help greenhouses implement and maintain effective food safety procedures.

Good agricultural practices in your greenhouse(s) will help you to:

- Assess the risks associated with your daily farming practices
- Minimize those risks
- Customize a food safety program for your individual farm
- Streamline record keeping and traceability requirements
- Sell to companies (if that is your goal) who require a food safety program
- Make sure community use/consumption of crops is safe

Crop grown in soil

N1. How will the produce be moved within the greenhouse, shipping, storage, to retail?

- ☐ Cardboard boxes
- ☐ Canvass or paper bags
- ☐ Plastic totes (see Figure 2)
  - ☐ Yes, there is a plan for cleaning between uses
- ☐ I do not know
- ☐ Other:

N2. Is there packaging or labelling that needs to be done before selling the produce?

- ☐ Yes
- ☐ No
- ☐ I do not know

N3. Is there a plan and/or equipment to clean, disinfect or replace these containers?

- ☐ Yes
- ☐ No
- ☐ I do not know

N4. Will the crops grown need to be cooled after harvesting or for storage?

- ☐ Yes
  - ☐ The budget, power and location are part of the plan
  - ☐ The plan meets food safety guidelines
- ☐ No
- ☐ I do not know

N5. Will produce be washed or packaged before it is marketed/distributed?

- ☐ Yes, a wash station with potable water will be required
- ☐ Yes, packaging or wrapping equipment will be required
- ☐ No
- ☐ I do not know

N6. If a vehicle and/or other transportation infrastructure is required, will it need to be purchased, leased or rented?

- ☐ Already own a vehicle
- ☐ Need to purchase
- ☐ Will lease/rent
- ☐ Not required
- ☐ I do not know

N7. Is there a value-added market for these products?

- ☐ Yes
- ☐ No
- ☐ I do not know

Next Steps: Evaluating Your Options and Implementing Your Project

Now that you have systematically worked through many of the key considerations when planning a successful greenhouse project, what next steps can you follow to get your greenhouse built and start operation?

1. First, assess your support and resources and put them into a list; an example is below. There may be multiple answers for each. Please add another group if they do not fit into the list. The list is only a starting point; assign them a numbering system for building solutions for the unknown part of the project. If you need to provide more information, attach a sheet of paper titled "Next Steps" with the corresponding number.

It is difficult to grow produce like peppers without a greenhouse

1) **Institutions (may include government, financial institutions, First Nations)**

   a) Name of Contact, company, number, website, what they supply.
   b) Agriculture Knowledge Centre, Ministry of Agriculture, 1-866-457-2377, Agriculture Info.
   c)

2) **Suppliers (may include local supply store, greenhouse supplier, seed company, etc.)**

   a) Name of contact, company, number, website, what they supply.
   b)
   c)

New varieties of tomatoes (colour and flavour) can be grown in a greenhouse

3) **Skilled trades (may include electrician, builder, contractor)**

   a) Name of Contact, company, number, website, what they supply
   b)
   c)

2. Assess your readiness and develop a plan.

Go through questions A1 through N7 and on the following page, mark all "I do not know" answers. These are areas requiring further research and/or consideration before moving forward with your project. For each key consideration listed as an "I do not know," put a check mark or notes in each column that applies. If a plan has been developed, please check "There is a plan." If there are professionals you are planning to contact for more information/assistance or have resources you will be referencing, place identify that "Resource."

Strawberries

	Question	I do not know.	There is a plan.	Resource	Question	I do not know.	There is a plan.	Resource	Question	I do not know.	There is a plan.	Resource
Example	G1	X		BB								
	A1				F1				K1			
	A2				F2				L1			
	A3				G1				L2			
	A4				G2				L3			
	B1				H1				L4			
	B2				H2				L5			
	B3				H3				L6			
	B4				H4				L7			
	C1				H5				M1			
	C2				I1				N1			
	C3				I2				N2			
	C4				I3				N3			
	D1				I4				N4			
	D2				I5				N5			
	D3				J1				N6			
	D4				J2				N7			
	D5											

*For question J3 please list that information at the bottom of the chart.

3. **Based on the self-assessment questions completed above, where do you place your readiness to move forward with your project on a scale from 1 (low readiness) to 5 (high readiness)? Check the readiness score that best applies to you.**

- ☐ 1 - Just starting or a large barrier is preventing the project from moving forward
- ☐ 2 - Low readiness, with considerable work needed to gather information on many decisions areas
- ☐ 3 - Approaching readiness; decisions have been made for several key consideration areas, but several areas remain that require further research and decision-making
- ☐ 4 - Almost there; waiting for some information or for approvals to be made
- ☐ 5 - High readiness; most key decisions have been made and incorporated into project plans

4. **Your next steps will depend greatly on your level of readiness and the areas requiring further research or consideration, as you have identified in questions 1 and 2 above.**

- ☐ Yes, the trades person, financial expert, regulatory and/or expert(s) have been identified.
- ☐ There are areas in which assistance is still required or have information you would like to double check.

Some examples of next steps include:

a. Schedule appointments with each of the professionals you have identified in Question 1 to provide expert advice on key consideration areas.

- If you are not already working with a skilled professional in the field you require, be sure to speak with several professionals you might decide to work with. Do not hesitate to ask about their experience with greenhouse operations and request references from their other clients to decide if they are the right fit for your project. It is recommended to obtain quotes from multiple manufacturers and service providers to ensure prices are at fair market value.

- Ministry of Agriculture specialists are available to provide support for those looking to develop a commercial business. Please refer to Ministry of Agriculture contact information on the last page.

b. If further input is needed from community members or end users (the customers who buy produce or products), schedule a community meeting or arrange an online survey to gather the input that you need.

- The methods that will work best will depend on who you need to consult with and the type of information you are seeking.
- Information on household vegetable preference may be gathered effectively through a survey. For broader questions related to land use decisions or community economic development strategies, a meeting may be more appropriate.

c. Writing a business plan is an essential component of a successful operation, whether it is a for-profit venture or a not-for-profit community operation.

- A business plan provides a road map and helps to organize the information about how you plan to run the operation into one document.
- One of the key goals in sustainability of the project is having a comprehensive business plan. The check list likely identified things that are not fully covered in the initial planning process. Therefore, it is beneficial to have a business plan that covers your purpose, business structure, human resources plan, marketing plan, production economics and financial plans and other key business planning areas. Consider working with a professional to have a business plan and feasibility study developed for your specific needs.

Programs and funding change often. This is not a complete list but these organizations can assist in understanding your business plan needs:

Business Development Bank Canada
https://www.bdc.ca/en
1-888-463-6232

Farm Credit Canada
https://www.fcc-fac.ca/en.html
1-(306)-780-5616

Clarence Campeau Development Fund
https://clarencecampeau.com/
1-(306)-657-4870

Community Futures
https://cfsask.ca/

Indigenous Business Development Services
https://ibdssk.com/
1-888-732-8999

MNP LLP
https://www.mnp.ca/en
1-877-500-0778

Saskatchewan Chamber of Commerce
https://saskchamber.com/
1-(306) 352-2671

Saskatchewan Indian Equity Foundation
https://sief.sk.ca/
1-(306)-955-4550

Sask Métis Economic Development Corporation
https://smedco.ca/
1-(306) 477-4350

Saskatoon Regional Economic Development Authority (SREDA)
https://sreda.com/
1-(306) 664-0720

Economic Development Regina
https://economicdevelopmentregina.com/
1-800-661-5099