Urban Farming in Central Indiana

A Training Manual Prepared by Big City Farms
to Support the Development of Emerging Urban Growers

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Created and published with the generous support of the
Indiana State Department of Agriculture, Specialty Crop Block Grant Program

2012

Cover photograph provided by the Felege Hiywot Center, Indianapolis, IN

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Introduction

The ways in which we grow food are integral to the health of our bodies and our communities. Farming is an activity that offers a clear window into our values and desires. Over the last hundred years, our food system has veered decisively from its original focus on small-scale, regionally specific food production, to one that is primarily concerned with its capacity to compete in the global marketplace. The result has been well documented in a wide range of sources: ecological devastation, market-driven abandonment of family farms, gutted local food economies, and a loss of food literacy that will, despite our best efforts, haunt us for generations to come.

In the face of this dominant mentality to 'get big or get out,' people around the country have been presenting an alternative to such a food system. They have been working hard to cultivate the land in the best way possible and make the case that good food and healthy communities are each dependent upon the vitality of the other. These farmers are in rural and urban areas alike, raising livestock, tending crops and, in the process, demonstrating the excitement and joy that is inherent in any thriving food system.

Big City Farms has, over the course of its existence, been committed to the idea that all communities, even urban ones, have the capacity to actively participate in their own food production. Numerous individuals have volunteered at the farm, excited to see how growing food in a highly urban area might work. Some of these volunteers have been interested in learning how they might create a thriving home garden, others are exploring ways to incorporate gardens into an educational setting, and still others have been excited by the idea of running their own urban farm.

With these people in mind, and with the support of the Indiana State Department of Agriculture, Big City Farms staff spent a significant part of the 2012 growing season creating this training manual for urban growers. We have tried to distill our experiences and opinions as best we can, so that other members of our community might be able to pursue their own agricultural dreams in an informed manner.

To be sure, we will have inadvertently ignored or omitted various pieces – including different methods of cultivation or pest control or crop selection and, most notable, livestock management. We have tried to focus on areas with which we are most familiar and practices that are integral to the operations of Big City Farms.

The farming knowledge that exists within our own community is vast and under-explored and we hope this manual will continue to be a work-in-progress. Instead of thinking of this as the final word on urban farming, think of it as an invitation to participate in the evolving conversation about what a healthy food system might look like, and what steps we can take to get there.

1. Land Use

There are an array of options and issues to consider when researching what land might be available and deciding what land to utilize for urban agricultural purposes. This section attempts to provide factors that could/should be considered when trying to acquire land, options that are currently available and options that might be made available in the future in Indianapolis.

Each future urban farmer should consider several factors when contemplating land use. These include, but are not limited to:

- *Size***.** It is important that each farmer focuses on "right sizing" their operation. Many farming operations start and fail quickly because they start out too big. Before pursuing land options, take plenty of time to consider what type of operation will fit you best. You can start to focus by deciding how much time you can devote each day/week/month/year to farming, by deciding if the growing space is income generating or for personal use and by deciding if you anticipate help in the form of paid labor and/or volunteers. Once these decisions are made, you can feel more comfortable in deciding what size growing area fits your needs and goals.
- *Soil content and health.* Heavy metals are a major concern in urban farming. Any potential farm site should have a soil test for heavy metals to determine what type of mitigation might be required before growing food. Detailed information on soil testing is available in the Site Assessment section of this manual.
- *Length of use*. Will the land be made available for one season, multiple seasons, indefinitely or permanently? Are there near/mid/long term plans for development on the site in question? These are vital questions to ask and finalize in advance of any land use agreement, as it is difficult to relocate a farm. The potential farmer should decide a minimum length of time they feel comfortable committing to in order to develop the type of farm they imagine.
- *Cost*. Is the land being made available for free, for rent or for trade? What monthly/yearly costs can the farmer incur on land and still have a financially viable farm? The current reality in urban agriculture is that land use likely needs to be "subsidized" by the private, public or institutional owner of the land, as urban land is typically too expensive to both purchase and realize a return on investment for agricultural purposes.
- *Zoning*. Are there any zoning restrictions that would limit or prohibit agricultural use of the land? Zoning should be investigated not only in relation to growing food, but also for temporary structures including hoop houses, greenhouses and storage units. Though these structures may not be in the initial plan of the farmer, as the farming operation matures, they may be of interest.
- *Water*. Is there currently a watering infrastructure on the land? If not, what are the possibilities to tap into a hydrant, run a utility line and/or utilize neighboring structures for rain catchment? A watering infrastructure is absolutely essential for a farm to thrive (this point cannot be made strongly enough), and figuring out water in the planning stage of the farm will save the farmer time, money and energy when building out the farm.

- *Location***.** Consider current and future living situations to determine whether the location of the farm site is amenable to daily travel to and from work. One must consider that farming often requires activities at very early and very late hours (i.e. – turning on/off water, laying out row cover, etc.), so the location should accommodate the unpredictable schedule of farming. Each farmer should also consider whether his or her farm size and model is best served on one single location or can be spread among several locations. If spreading the farm out, for example by farming on residential lots, consider the maximum distance between lots that will still allow the farm to run efficiently and commit to stay within this footprint.
- *Storage***.** What are the possibilities for storing tools, supplies and harvested vegetables on/near the farm site? If refrigeration and/or frequent power tools will be required, what possibilities are there for an electrical hookup? It is advisable to figure out storage needs and possibilities in advance of the farming season to save time, money and energy.
- *Distance to distribution***.** The farmer should consider the proximity of the farm to their customer base. Whether the distribution model is CSA, farmers market, restaurant sales, etc., the farmer should determine how important proximity to their end market is for distributing product and marketing the farm.

Land Use Options

Although the land use options below do not necessarily fit neatly into only one specific category presented, we have attempted to organize options by providing three broad categories for consideration when searching for urban farm land.

Public

Larger projects on public parkland typically require an organizational structure (and frequently grant support) to build out and maintain the farming operation, as well as non-profit status. For individuals who want to focus on growing in smaller spaces and gear their operation for profit or personal use, an option is the Indianapolis Office of Sustainability – Indy Urban Garden Program. Through the Indianapolis Land Bank, more than 100 lots have been made available for free for farming purposes. Individuals must apply to farm the lot(s) and if approved for use, the land can be used for a minimum of five years (www.indygov.org/eGov/City/DPW/SustainIndy/Life/Garden/Pages/IndyUrbanGardenProgram.aspx).

One example of a large project on public land is the Indy Urban Acres Farm at 21st Street and Shadeland Avenue which began in the 2011 growing season. The farm is funded by Indiana University Health and is a project of the Indy Parks Foundation located on Indy Parks land. The farm will grow up to eight acres, and the crops grown by a grant-funded farm manager will be provided to Gleaners Food Bank (www.indyparksfoundation.org/site/what_we_do/indy_urban_acres_farm).

A second public land project is the Wishard Slow Food Garden at White River State Park which is a project of the non-profit Growing Places Indy. The farm is on 6,000 square feet and is designed to encourage residents of Indianapolis and visitors to the city to consider

how they might be able to eat from a local food system. The farm is partially grant-funded and sells its produce to restaurants, at farmers market and through a CSA, as well as donates crops to a downtown neighborhood. In addition, Growing Places Indy runs a ten-week summer internship program for high school and college students (www.growingplacesindy.org).

Private

Despite more than one million residents in the Indianapolis metro area, the city is not particularly population dense and potential farmland can be found in any corner of the city. Within the sector of privately owned land there are many possibilities and options.

Privately Owned Lots

An increasing number of farming operations are sprouting up on privately owned residential lots, or privately owned commercial lots. Arrangements such as these are typically born out of conversations in neighborhoods with neighbors. Lot owners are often extremely amendable to farming operations on their properties as it passes maintenance responsibilities onto the farmer, beautifies the lot and has the potential for the lot owner to earn some money on the land (through a rental agreement) or trade for vegetables grown on the property. Big City Farms has operated using this model since the 2009 growing season.

Backyard Gardens

In many locations around the country, farmers utilize a series of backyards to earn income. Arrangements can take many different forms from contract growing for individual families, to simply utilizing the land for a farming operation.

Restaurant Gardens

With the increase in the number of restaurants focusing on local sourcing, restaurants are increasingly interested in having their own on-site gardens. R Bistro and Goose the Market currently have on site gardens that are tended by contract growers or hourly employees. Restaurants benefit from such arrangements not only in the use of the produce, but also in the way that such sites can serve as a useful marketing tool and a location for restaurant patrons to spend time while waiting for a table or after their meal.

Personal Yards

For small-scale growers, the personal front and/or back yard is a great location to learn how to garden. Growers will benefit from having their farming activities on the same site where they live. Personal yard gardening is a great way to decrease one's food budget, as well as having the chance to sell small amounts of product overages to earn additional income. If a grower can learn important lessons on a small, personal scale it may make the prospect of scaling up to a small farming operation much less intimidating and much more achievable.

Community Gardens

Community gardens take many different models depending on the organization that is administering the garden itself. The most common model is that growers rent a small plot

on a yearly basis for their own use. Much like a personal yard garden, a community garden plot is a great way to start to learn how to grow vegetables and a way to sell overages for additional income.

A current list of gardens and farms in Indianapolis is available in Appendix A.

Institutional

The term institutional here is being used to describe land and farming options that are part of, or in partnership with, a larger public or private organization.

Hospitals and Health Centers

Public and private health care providers are increasingly paying attention to the prevention possibilities resulting from healthier food choices in their populations. The logic is that fewer diet-related illnesses will occur if patients' diets improve. This will reduce the occasions that a patient has to seek health care, resulting in a cost savings for the health care provider over the long term.

As mentioned in the private land use section above, Indiana University Health has funded an eight-acre farm with produce being donated to a food bank. In addition, Wishard Hospital will have its own 6,000 square foot "Sky Farm" on the roof of its new hospital, which will open in 2014. The goal of the Sky Farm is to provide both educational experiences for patients and families and to provide fruits and vegetables to the hospital's food service.

Hospitals and health centers often have the benefit of on-site land that is typically underutilized. A scenario can be imagined where hospitals and health centers have on-site farms and on-site farmers that provide educational experiences and fresh food for staff and patients. Such arrangements could be "subsidized" by providing free land to farmers in exchange for educational programming and/or some amount of produce. This would allow the farmer to be a benefit to the health center and devote a portion of the growing space to a for-profit endeavor while getting healthy food onto the plates of those whose health is most at risk.

Colleges and Universities

The Butler University Center for Urban Ecology has developed a two-acre campus farm (www.butler.edu/urban-ecology/urban-farm). The farm has employed a grant-funded farm manager for three years, which will allow the farm manager to build out the farm and develop a sustainable for-profit farming model over the three years. After that time, the arrangement will be similar to the one mentioned above, with the for-profit farmer being "subsidized" by the university in the form of free land in exchange for continuing to run educational programming for the university.

In addition, IUPUI has developed an on-campus community garden called DIGS (www.iupuidigs.com) with the dual objectives of promoting and teaching the process and benefits of sustainable urban gardening. Like many institutions, land is frequently available at colleges and universities and if the farming project can benefit both farmer and

institution, and an ethic of agriculture and sustainability is made to be institutionally important, then more models like the Butler CUE farm and DIGS could develop.

Community Development Corporations
In Indianapolis, Community Development Corporations (CDCs) are typically asked to assist with affordable housing, job creation and neighborhood revitalization. As neighborhood partners who have a vested interest in increasing the health of neighborhoods and to find contributing land use models, urban farming is a natural fit for such organizations.

An example is South Circle Farm (www.southcirclefarm.com) in the Concord neighborhood on the near southside, which started in the 2011 growing season. The Concord CDC purchased a three-acre site with the intention of developing an urban farm. Through grant and stimulus money, the farm infrastructure was established under the consultation of the farm's first private farmer. The arrangement benefits both parties in that the CDC, which has no expertise in farming but wants a farm on-site, gets the farm they desire and the farmer receives a subsidy in the form of a consulting fee to build the farm and free use of the land moving forward. In exchange, the farmer has agreed to run educational programs and sell subsidized vegetables in the Concord neighborhood. The Concord/South Circle Farm collaboration is a good model that could be replicated to bring additional farms to many neighborhoods.

Schools
The schoolyard garden movement, which gained traction in 1995 with Alice Waters in Berkeley, California at Martin Luther King, Jr. Middle School, is starting to take hold all over the country. Schools are seeing the benefits of serving school-grown vegetables in their cafeterias and integrating their gardens into various parts of their curriculum (science, math, art, physical education, etc.). Many schools, particularly in suburban areas but also in urban areas, have the benefit of sufficient land that goes almost unused for any purpose other than growing grass. There is a great opportunity for future farmers to partner with schools for the development of farming initiatives and schools such as Herron High School and The Project School have already started with initiatives on their campuses.

Churches
Once again, church campuses often have the great advantage of large pieces of land that goes unused for any purpose other than growing grass. Here again is an opportunity for potential growers to make a strong argument for an arrangement that benefits both grower and institution. An example would be developing a private farm on church property where land use could be exchanged for a portion of the harvested produce.

Land Use Summary
Urban farming is still very much in its infancy, and many of the forms it could take have not yet been imagined and are certainly not presented here. The limits are only in the imagination of future farmers. Experience shows us that good farming models can be executed in infinite ways and sometimes the only barrier to land use (including free land use) is asking permission and working hard towards a mutually beneficial goal.

2. Site Assessment

Once a geographic location has been selected, the next step in designing a successful farm system is to analyze the site in regards to its soil quality, potential contamination, sun exposure, water supply, and physical layout considerations that should be factored in to the assessment and planning process. This sort of thorough site assessment is key to understanding exactly what one is working with, and how it might be improved upon to best suit your farm's needs. This is a critical stage in the farm planning process, as many of the decisions made here should be considered permanent. It is easy to get swept away with new possibilities and the excitement of an upcoming growing season and, in the process, cut corners in the planning and physical layout of the farm. However, it will always be more efficient to set aside sufficient planning time, determine the best course of action and pursue that goal rather than make decisions that will be regretted and must be corrected in the future.

A Quick Word on Soil Types

Soil composition can vary significantly from one site to the next, even within a single site. Additionally, the productive capacity of a particular site can depend greatly upon materials present within a given soil, and the role they play in the cultivation of fruits and vegetables.

Much of the soil in central Indiana is dominated by clay – a material whose densely packed particles are able to hold water well and can contain significant stores of nutrients. Clay soil can also be difficult to cultivate, due to this high density and the resulting heaviness of the material.

Sandy soil is composed of loosely packed particles that circulate water and air very easily. Silt is a soil classification that is somewhere between clay and sand. Ideal soil composition for vegetable production would include a mixture of all of these types, and can be achieved through conscientious planning and bed preparation, almost regardless of the original soil's character.

Soil Tests

The first step in a site assessment should be a comprehensive soil examination. Healthy plants need healthy soil, without fail, and anything you can do to improve the soil conditions will be rewarded in future harvests. To start this process, soil samples need to be taken from the selected site. There are numerous soil labs around the country that conduct testing, for a modest fee.

Big City Farms has used the Soil and Plant Tissue Testing Laboratory at the University of Massachusetts, Amherst (www.umass.edu/soiltest/index.htm) over the past three years, with positive experience. The soil tests that the university performs can be customized to focus on specific aspects of a soil's characteristics, including available organic matter, soluble salts, soil texture, and total nitrogen. **An example of a UMASS soil sample is included in Appendix B.** A more local service for Indianapolis residents is offered by Dr.

Gabriel Filippelli of the Center for Urban Health at Indiana University-Purdue University, Indianapolis (www.urbanhealth.iupui.edu).

With both of these testing services, the results will be accompanied by a detailed breakdown of existing nutrients, micronutrients and pH levels, along with general recommendations on steps one might take in order to achieve ideal growing conditions for the selected crops. **A thorough explanation of soil sampling instructions can be found in Appendix C** (www.hort.purdue.edu/ext/HO-71.pdf).

Soil Contamination

One thing to pay special attention to, in regards to using urban land for agricultural purposes, is the possible presence of hazardous contaminants due to human-related activities. These contaminants might include lead, petroleum hydrocarbons, arsenic, and residual insecticides. A thorough soil test from one of the previously mentioned services will screen for such contaminants in regards to their presence and relative quantity.

The presence of lead and other hazardous materials should not necessarily be viewed as an insurmountable obstacle for a successful farm. This simply means that one has to be significantly more conscientious about specific land use and bed construction than if one were working in clean, fallow ground. Recent studies have shown that there is greater risk associated with surface exposure than with absorption of such chemicals by plants.

What this means, in practical terms, is that one should be careful to provide a significant (6-18 inches) layer of clean (uncontaminated) organic material on top of contaminated soil (the depth of this added layer will be relative to the amount of contaminants within the soil). This clean organic matter might consist of wood chips, topsoil, compost, leaves, straw, etc. The goal is to provide a solid barrier between the eventual growing layer and the original layer, so that one's harvesting or cultivation practices do not disturb contaminated soil particles.

These techniques, often associated with growing in raised beds, are discussed in greater depth in the section related to bed building. The following websites contain excellent information about soil contamination and the steps one can take to mitigate the risks associated with farming on contaminated land:
www.aiswcd.org/IUMPDF/appendix/u03.pdf
www.cepm.louisville.edu/Pubs_WPapers/practiceguides/PG25.pdf

Sunlight

Adequate sunlight is crucial to a plant's growth – the process of photosynthesis (which depends upon available sunlight) is the only way that plants are able to produce food for themselves and thrive. As such, the availability of sunlight over the course of the year should be monitored when determining the layout of any future growing site.

Nearly all food crops require full sun (a minimum of six hours of unimpeded sunlight per day), so it is important not to locate growing areas alongside potential obstructions. The sun's impact will change over the course of a year, as the tilt of the earth will affect the

sun's path. From the late fall through early spring, this path will be predominately in the south, as the sun rises in the southeast and sets in the southwest. This reduced arc will make growing areas along the southern edge of a property particularly susceptible to shadows from possible obstructions on the southern perimeter.

The impact that such surroundings might have on production capacity should be taken into account when one is laying out a growing space and creating a crop plan. For example, if there is a building that borders the southern edge of the farm, it would be unwise to grow winter greens within the southernmost beds as they might not receive sufficient sunlight during the winter months.

Water

Water is another key element to a plant's survival and success. There are certainly regionally-adapted plants that might require less water than others (as is the case for plant varieties indigenous to the southwestern region of the United States), but the vast majority of vegetables common to the American consumer require an average of one inch of water per week for healthy growth and production. This need should not be ignored in the planning stages of a farm, as the logistics of ensuring adequate irrigation can be complicated and time-consuming. It is best to explore available options and decide upon an informal irrigation 'protocol' prior to planting any seeds.

There are often several watering options available to urban growers, largely due to the fact that many urban areas have established infrastructure to provide residents with safe, clean drinking water. The complexity of the situation is largely due to how a grower is best able to access that water supply and apply it to the growing area.

Big City Farms has employed a variety of techniques to ensure that its plantings receive adequate water during dry periods – particularly in late summer/early fall. The farm has utilized existing spigots on neighboring houses to access city water, running hoses from the house onto the growing area. These hoses are then used to hand-water plants or, more frequently, will be connected with common yard sprinklers that are able to cover a large area and can be easily moved, according to needs.

When growing in a city where there is often a tremendous amount of material available for the taking, it may be reasonable to think of a neighbor's spigot as a source of free water. Using such resources, though, should always be discussed and cleared with the appropriate owner, to maintain positive relations with neighbors and potential partners. To this end, always volunteer to compensate the homeowner for any water that might be used for irrigation purposes.

Another approach that Big City Farms has taken is to rent a temporary hydrant meter from the local water company. This is a straightforward process that requires the purchase of a hydrant wrench (for unscrewing the hydrant caps) and signing a contract with the water company in exchange for the meter. There is a small daily rental fee, in addition to a usage fee per 100 cubic feet of water that is used. While this process might seem expensive or time-consuming (attaching the meter, relocating it to another site if necessary, etc.), it is

probably the best way to ensure a steady supply of clean water for an urban farm. More information about renting temporary water meters in the Indianapolis area is available at: www.citizenswater.com/My-Service/TemporaryHydrant.aspx

The choice of irrigation method is often dependent on the availability of a permanent water source, and the costs associated with purchasing and installing a full-fledged irrigation system. At the outset, it is advisable to wait to purchase irrigation materials, such as drip tape and elaborate sprinkling devices, until at least one season has passed. The experience of using a particular plot of land, as well as the experience of marketing a wide range of vegetables to a discerning public, will help inform the decision-making process and might convince the grower that a complicated irrigation system is simply unnecessary for the types of crops that will be grown.

Layout Considerations

Due to the fact that every farm is different in its goals and operations, it is difficult to prescribe a farm design plan that will be applicable to every one. There are, however, some basic factors that should also be considered in these initial, planning stages. These include:

- *Bed Placement and Orientation.* In order to maximize available sunlight, vegetable beds should be laid out running east to west. This will help insure that taller plants do not, inadvertently, block the sunlight from reaching lower-growing plants.
- *Compost Bin Placement.* Whether or not the production and application of compost is a major factor in your particular farm, it is inevitable that there will be food waste (whether it is leftover produce that did not sell and is now inedible, or the remains of plants whose edible portions have been harvested) created on-site, and it is helpful to have a dedicated spot for such materials. It should also be easily accessible and of a manageable size, to facilitate use and upkeep.
- *Wash Area.* A clean, functioning wash station is an important part of any farm that is specializing in fresh produce. Once harvested, fruits and vegetables need to be rapidly cooled in order to preserve their appearance and maintain their shelf life potential. A functioning wash area will go a long way to ensuring that your customers are happy with vegetables that might have been picked up to twenty-four hours before the point of sale. If there is a particularly shady area within a chosen site, this would be an excellent spot to locate a wash area. It should have ready access to clean water, include multiple bins for washing and/or soaking numerous types of vegetables, and have an elevated area where vegetables can be cleaned. Simple wooden tables with a wire mesh top work well for this – the mesh ensures that the dirt attached to the vegetables has somewhere to go after being sprayed off, and the washed vegetables are able to dry properly.
- *Tool Storage.* This does not necessarily have to be on-site, but it is certainly convenient if there is an easily accessible storage place where frequently used hand tools can be kept. If it is financially and aesthetically feasible, a used shipping container is an excellent option for a storage shed – it is dry, secure, stable, and can provide a convenient backdrop for any farm signage that might be necessary and/or desirable to post.

The question that you should ask yourself throughout the planning process is 'How can I make this process more efficient?' Farming is hard work that demands a high level of competency across a wide range of tasks. The fewer obstacles there are to completing one of these tasks means that it will be less tiring, it is more likely to be completed, and it will take less time to complete. Despite customer excitement and support for well-grown vegetables, there is a limit to the price people will pay for produce. You will have more time to pay attention to growing the best possible produce at a reasonable price by increasing the efficiency of your operation.

3. Bed Building

Advantages of Using Raised Beds
A raised bed is ideal for the urban farmer interested in maximizing limited space and keeping that space aesthetically pleasing. On plots where soil is contaminated or where drainage is a concern, raised beds can help improve the overall growing environment. Instead of battling poor soil conditions, raised beds are built above ground, where a farmer can have more control over the soil texture and ingredients. Sometimes when building a raised bed the native soil is incorporated, sometimes not.

A frame, which is optional, will contain the soil and can be constructed of wood (avoid painted, or stained wood), hay bales, brick, stone, concrete block, or any number of found materials. A raised bed can be a free form shape, with soil and amendments piled several inches high. Ideally the bed will consist of six inches or more of compost-enriched soil, a mixture of available topsoil (if not contaminated), manure, compost, and any other necessary soil amendments (based on the results of a reliable soil test). In regards to soil, start with what is available and add to it as often as you can.

Once the growing area is established, the working bed itself becomes more of a system in flux, the surface of it changing throughout the season as organic matter is routinely added. In most cases these soil materials will have to be outsourced, but can probably be acquired locally. Aside from avoiding the issue of poor soil, raised beds warm more quickly in spring and allow a farmer to work the soil earlier. The soil in a raised bed drains better, and is less likely to become compacted. Constructed with accessibility in mind, a raised bed can cause less strain on the bodies of those working in them. After the initial construction process is completed, raised beds require less maintenance than conventional garden beds.
www.organicgardening.about.com/od/startinganorganicgarden/a/raisedbed.htm

Determining the Size and Shape of Raised Beds
It is smart to design the layout of your beds and to mark them off before you start digging or adding any composted growing material. You can use string and stakes and adjust them until you get the size and shape you want. Rope or a garden hose might be a good option for beds with curved borders, or simply mark your borders in non-toxic paint. Keep in mind, a simple layout is much easier to manage and is equally functional as an elaborate one.

The dimensions of the bed will vary depending upon the space available and how many beds can be constructed on the plot. Make sure that you can access all parts of the bed without stepping into it. Being able to reach the middle of the bed from either side is important for planting and harvesting activities. In other words, keep half the bed's width within an arms length.

It is also important to consider the spaces surrounding the bed space as this is the site of all foot traffic on your farm. Wheelbarrows, wagons, carts, lawn mowers, tillers, and multi-purpose equipment will need to navigate this system of raised beds using these walkways,

and the easier it is to do so, the better. If it is a natural space (lawn, soil, cover crop, or wood chips) weeds, insects, mold, fungi, and any number of detriments can live here and directly affect the health/productivity of the crops. This space can also be designed with slate, gravel, concrete, brick, and many other types of material.
www.organicgardening.about.com/od/startinganorganicgarden/a/raisedbed.htm

How to Make a Raised Bed

- *No-Dig Method.* This "no-digging" method of building a raised bed from scratch takes more time and will be ready for planting by the following season. First, spread six inches of manure over the area to be planted. Add any type of compost (dry leaves, weeds, wood shavings, hay, or vegetable matter) that you can find.
  It may be helpful to spread limestone (not quick lime) over the area at a rate of fifty pounds per 1000 square feet. In the late summer or early fall, cover the area with a material that is impervious to light and is heavy enough to hold all of the additives close to the earth, such as unopened hay bales (which can be opened and used as mulch throughout the next season, hopefully loaded with earthworms and mycelium), black plastic anchored with rocks, or metal roofing anchored with rocks. This will help the organic matter and soil mix together, and also help break down the sod. Uncover the area in the spring- the longer the cover is left on, the better. The finished soil will be loose and loaded with microbes. It will need little further preparation other than tilling.

- *Dig Method.* Another method for building a bed requires less time but more labor. If getting plants into the ground is your highest priority this may be the better method. This method does little for adding microbes into the soil, but after two or three years it should be as fertile as the previous method.
  Whether it is grass, gravel, or an existing planting, you will need to completely clear the area, which is the hardest part of the entire process. First, turn the soil to get rid of the sod. With a flat shovel, cut through the sod making six to twelve inch squares. With a sharp spade shovel, or garden fork, dig out each square and put it in a wheelbarrow or garden cart. When all of the sod has been removed, add several inches (or as much as you can) of ready manure, compost, organic matter and/or lime (at a rate of fifty pounds per 1000 square feet. Incorporate the compost with a tiller or shovel (the double-digging method can be applied at this point). If time allows, plant a cover crop such as clover, forage beets, alfalfa, or other tap rooted crops to help break up the subsoil and to pull minerals up into the root zone.
  - *Homesteading In The 21st Century. George Nash and Jane Waterman, p. 165*

- *Double-Dig Method.* The double-dig method for building a bed is a simple way to incorporate compost and manure into the existing soil once the sod has been removed. First, dig a trench about one foot wide and about as deep as the shovel blade (six to ten inches deep). Place the soil on a tarp just to one side of the trench. Loosen the subsoil at the bottom of the trench using the tines of a garden fork or a broadfork. Rock them back and forth as deeply as possible. Spread manure and compost over the aerated and loosed subsoil. Next, dig another trench alongside the

first, turning the removed soil into the first trench and spreading it over the top of the added compost and manure. Once the second trench has been dug, loosen the subsoil at the bottom, add compost and manure, and cover it with the removed soil of the first trench. - *The Backyard Homestead. Carleen Madigan. p. 39*

- *Building a Raised Bed and Frame.* You can choose from a variety of materials to construct the frame of your raised bed. Wood is a very popular choice, because it is easy to work with and it is inexpensive. Concrete blocks, natural stone, or brick are also nice options, but there is an added expense and labor to consider in using them. Some farmers simply place bales of hay or straw in whatever configuration they desire then fill the defined space with good soil and compost. This solution will only give you a year of use because the straw will decompose, but it is worth trying if you do not mind replacing the bales annually, or if you are still developing a more permanent solution.

  If you choose to use lumber, use rot-resistant lumber such as cedar, one of the newer composite lumbers made from recycled plastic or pressure-treated lumber to construct your bed frame. Two by six boards are a good start as they are easy to work with and will give you six inches of soil depth above ground. Cut your pieces to the desired size then attach them together to make a simple frame. You can attach them in a variety of ways. Either make a simple butt joint at each corner, pre-drilling and then screwing the corners together with galvanized screws, or use a small piece of wood in the corner and attach each side to it. Using a level, make sure your frame is level in all directions. This is a necessary step because if your bed is not level, water will run off of one part of the bed or sit in another. If part of your frame is high, just remove some of the soil beneath it until you have a level frame.
  The whole point of a raised bed is that it gives you the opportunity to grow in ideal soil. Take this opportunity to fill your bed with a good mixture of quality soil, compost, and decomposed manure. Once they are filled and raked level, you are ready to plant or sow seeds.
  www.organicgardening.about.com/od/startinganorganicgarden/a/raisedbed.htm

- *Lasagna Gardening or Layered Bed Method.* Lasagna gardening (or sheet composting) is an efficient, no-dig, no-till growing method for making a new bed that utilizes a practice of composting directly into the bed space. To make a lasagna bed, organic matter is added in layers (hence the term "lasagna garden," coined by garden writer Patricia Lanza) that break down over time, into a nutrient-rich, fluffy soil right where you need it.

  The first layer of your lasagna garden consists of either brown corrugated cardboard or three layers of newspaper laid directly on top of the grass or weeds in the area you have selected for your bed. Wet this layer down to keep everything in place and start the decomposition process. The grass or weeds will break down fairly quickly because they will be smothered by the newspaper or cardboard, as well as by the materials you are going to layer on top of them. This first layer also

provides a dark, moist area to attract earthworms that will loosen up the soil as they tunnel through it. Anything you would put into a compost pile, you can put into a lasagna bed. The materials you put into the garden will break down, providing nutrient-rich, crumbly soil in which to plant. Alternate layers of “browns” (fall leaves, shredded newspaper, peat, and pine needles) with layers of “greens” (vegetable scraps, garden trimmings, and grass clippings) to achieve a suitable mix. In general, you want your "brown” layers to be about twice as deep as your “green” layers, but there is no need to get finicky about this. Just layer browns and greens, and a lasagna garden will result. What you want at the end of your layering process is a two-foot tall layered bed. It will shrink down in a few weeks.

Fall is an optimum time to start your lasagna bed because of the amount of organic materials you can get from fallen leaves and general yard waste. You can let the bed sit and break down all winter. By spring, it will be ready for planting. Also, fall rains and winter snow will keep the materials moist, which will help them break down faster. If you choose to make a lasagna bed in spring or summer, you will need to consider adding more "soil-like" amendments to the bed, such as peat moss or topsoil, so that you can plant right away. If you make the bed in spring, layer as many greens and browns as you can, with layers of finished compost, peat, or topsoil interspersed in them. Finish off the entire bed with three or four inches of finished compost or topsoil, and then plant. The bed will settle some over the season as the layers underneath decompose. When it is time to plant, just dig down into the bed as you would with any other raised bed. If you used newspaper as your bottom layer, the shovel will most likely go right through, exposing nice, loose soil underneath. If you used cardboard, you may have to cut a hole in it at each spot where you want to plant something. This layer of newspaper and/or cardboard will act as a weed suppressant. Add mulch to the top of the bed in the form of straw, grass clippings, bark mulch, or chopped leaves to retain soil moisture.

"Greens" for Lasagna Garden
Fruit and vegetable scraps
Grass clippings
Coffee grounds, tea bags, tea leaves
Seaweed
Weeds that have not set seed
Trimmings from the garden

"Browns" for Lasagna Garden
Shredded paper, newspaper
Pine needles
Straw
Peat moss
Fall leaves

www.organicgardening.about.com/od/startinganorganicgarden/a/lasagnagarden.htm

Growing on Industrial Land
For the urban grower who is attempting to grow on a site which might be severely nutrient deficient or contaminated additional back-fill material may be required, acting as a barrier between the actual growing medium of the raised beds and the contaminated soil on site. Raised beds can be built on top of a foundation consisting of layers of flattened cardboard (which may be obtained locally from recycling centers and other institutions) and woodchips (which can be acquired locally as well). This layered foundation can be built up as tall as is needed. Sometimes three feet or more is necessary to keep the tap roots of crops from drawing nutrients up through the barrier of woodchips and cardboard from the contaminated soil below. A method similar to this has been successfully utilized at the South Circle Farm in Indianapolis.

Managing Mulch
Cool mulches such as straw, pine needles, and newspaper can help control weeds by blocking visible light from reaching the soil while allowing rainwater to penetrate. They minimize the rate of evaporation thus keeping the plant roots moist even in the driest times of the season. Temperatures beneath a cooling mulch can be several degrees cooler than that of the ambient air temperature.

Warm mulches, such as black polyethylene mulch, black landscape fabric, and IRT-100 help warm and hold the temperature of the soil. Unfortunately, none of these types of mulch are biodegradable and can be difficult to remove from a bed without tearing, at which point they are unusable and are normally discarded. Mulch can also be a beneficial method of weed control, moisture retention, and soil improvement. Avoid using mulch in very wet seasons as it can harbor slugs and serve as an incubator for a plethora of unwanted fungal, bacterial, or viral diseases.

Some people believe in tilling mulch under in the fall to prevent insect pests from overwintering, then planting a green-manure cover crop, which will be tilled under in the spring. Others decide to wait until spring to till the mulch under, but pulling any over-wintered mulch to a side as soon as snow melts to hasten soil warming and drying.
-*The Backyard Homestead. Carleen Madigan. p. 35*

4. Managing Soil Fertility

This section will present various methods of, and some of the ideology behind, building and maintaining healthy soil. Understanding and nurturing life in the soil is an important aspect in growing high-quality produce. It may take some experimentation to find the combination of methods that work best for your specific needs.

Crop Rotation

A well-conceived crop rotation is one of the most effective tools for managing soil fertility on a multi-cropped farm. A grower can avoid soil depletion, intense weed problems, pest infestations, and prevent disease by practicing a simple crop rotation. Planting the same crops into the same location, year after year, will result in that particular soil being overworked. To avoid this, a common approach on many multi-vegetable farms is to rotate plantings of vegetable crops by family. Another strategy is to alternate vegetable crops with forage crops, cover crops, or green manure, such as small grains, alfalfa or clovers. By changing the crop that is planted in a particular place every season, or even multiple times in one season, less harm is done to the soil.

A plan for crop rotation can be designed if a grower knows how a specific crop affects his or her specific soil. He or she can plant a crop with properties that neutralize or compliment the effects of the previous planting. An example of crop rotation in large-scale conventional farming is corn, then soy, and then corn again. Though this example does not promote long-term health of the soil, just planting corn year after year would destroy the soil completely. The basic introduction of soybeans into this crop rotations mitigates the damage that might be done if only corn was planted year after year. When cover crops and green manure are added to your crop rotation plan, immediate affects are often unnoticeable. With persistence, however, it has been proven to be an effective way of growing successful crops while not depleting the soil of necessary nutrients.

The best way to start developing an effective crop rotation for your farm is to pay close attention to the growing area. Experience and research is your best guide, so take careful notes. Plants will leave clues as to what nutrients they may or may not need. Too many growers rotate their crops by relying on memory and making snap decisions when planting. To make the most of crop rotation you need detailed records of where crops were grown in the past as well as a written plan for how crops will be arranged in the future. When making a crop rotation plan, a grower must consider many variables. The number of beds, number of crops, amount of space in the beds for each crop (e.g. – one squash plant occupies more bed space than one carrot), and the amount of time are all important factors to consider when designing your crop plan.

Start by making a map of your farm. Label the beds, including their dimensions or square footage. Make photocopies of the map and at the end of each season fill one in and date it, noting any serious pest or soil problems in a field. Prior to the growing season, fill in a new map with your best guess as to where crops will be planted, depending on growing conditions, etc. Try to develop a plan that results in the most number of years between

planting similar crops in a given location. A free online version of a crop rotation manual is available at:
www.sare.org/Learning-Center/Books/Crop-Rotation-on-Organic-Farms

A practical example of a crop rotation is one designed and used by Elliot Coleman in *The New Organic Grower.* His goal was to feed sixty people, using one and one-half acres, and a separate garden for salad greens. He has found the following crop rotation to be successful, and it is an excellent starting point for beginning farmers:

- *Potatoes* follow sweet corn because corn can most benefit the yield of potatoes.
- *Sweet corn* follows the cabbage family because corn shows no yield decline when following brassicas, and cabbage can be undersown to a leguminous green manure which, when turned under the following spring, provides the most ideal growing conditions for sweet corn.
- *The Cabbage Family* follows peas because the pea crop can be finished and cleared by August 1, allowing a vigorous winter green manure crop to be established.
- *Peas* follow tomatoes because they need an early seed bed, and tomatoes can be undersown to a non-winter-hardy green manure crop that provides soil protection over winter with no decomposition and regrowth problems in the spring
- *Tomatoes* follow beans because this places them four years away from their close cousin, the potato.
- *Beans* follow root crops because they are not known to be subject to the detrimental effect that certain root crops such as carrots and beets may exert in the following year
- *Root Crops* follow squash (and potatoes) because those two are both good "cleaning" crops (and can be kept weed-free relatively easily); thus there are fewer weeds to contend with in the root crops, which are among the most difficult to keep cleanly cultivated. Also, squash has been shown to be a beneficial preceding crop for roots.
- *Squash* follows potatoes in order to have the two "cleaning" crops back to back prior to the root crops, thus reducing weed problems in the root crops.
  -*The New Organic Grower. Elliot Coleman, p.66*

Cover Crops
A cover crop is a crop which is planted in a bed not currently being used for market crops to help prevent erosion of the bare soil. The biomass produced from growing a cover crop can be incorporated into the soil, increasing its organic matter content. This biomass is biological material created from living or recently living organisms and is a nutrient rich food for plants.

Planting a cover crop can help prevent soil problems that affect plant growth, improve soil texture, and increase the soil's ability to hold nutrients and moisture. Deep-rooted cover crops can penetrate heavy clay, opening up passages for increased water and air flow. Leguminous cover crops are able to increase the amount of nitrogen available in the soil, a process known as *nitrogen fixation*. Legumes contain symbiotic bacteria called *rhizobia* within the nodules of their root systems that produce nitrogen compounds. Plants use these compounds to grow. When the plant dies the fixed nitrogen is released into the soil,

becoming available to other plants. Many cover crops can suppress weed growth by producing thick canopies that prevent light from reaching the surface of the soil. This can weaken competing weed and suppress weed seed germination. Cover crops have also been reported to exhibit allelopathic effects. Allelopathy is the beneficial or harmful influence of one plant on another plant by the secretion of a chemical or toxic substance. For example, annual rye releases a chemical through its roots that prevents certain seeds from germinating.

It may be helpful to take soil tests before cover crops are planted. These tests may provide a baseline of information regarding the nitrogen, phosphorus, potassium, organic matter content, and pH level of your soil. This information can be used to evaluate crop fertility requirements and to help track the progress of a preventative/restorative cover crop program. There are generally two different categories of cover crop, warm-season cover crops which grow during the warm months of the year, and cool-season cover crops which grow during the cool months. Cover crops can be further classified as legumes and non-legumes. The distinct difference between the two is that legumes can fix nitrogen in the soil whereas non-legumes are used primarily for weed suppression and for increasing organic matter.
www.georgiaorganics.org/ForFarmers/CropProduction/CropPlanning/CoverCropsforSoilImprovementinHorticulturalCrops.pdf

The Midwest Cover Crops Council has substantial information related to Midwest-specific cover cropping practices at their website:
www.mccc.msu.edu

Cover Crop Manual (free online version)
http://www.sare.org/Learning-Center/Books/Managing-Cover-Crops-Profitably-3rd-Edition

Green Manure

Green manure is a term used to describe the practice of planting nonmarket crops, including those used as a cover crop, for beneficial purposes between and during plantings of market crops. The practice is useful for nurturing the soil (even during winter), keeping weeds down, and attracting beneficial insects. A green manure crop can be seeded around an established market crop in the bed at the same time. This practice is known as undersowing, overseeding, and companion planting. The concept is that the under sown green manure crop offers assistance in some way to the neighboring market crop. This assistance can be in the form of shade, nutrients, depth of roots, water requirements, or pest control.

Another advantage of undersowing a green manure crop is that it will be established by the time the market crop is ready to be harvested, eliminating unproductive time between plantings and, thus never exposing the soil. By giving the market crop a four to five week head start the undersown green-manure crop poses little competition for soil nutrients, and is therefore not a threat to the market crop. Some growers will also manage a green manure crop specifically as a compost ingredient because their extensive vegetable production requires that the soil be amended more frequently.

Many leguminous green-manure crops have deep-rooting abilities that help open and loosen soil that has been compacted, such as the clay-rich soil of Indianapolis, and can benefit the following planting by making it easier for the roots to reach nutrients and moisture. Lupines, sweet clover, and alfalfa, are a few examples of a leguminous green manure. They also help make nitrogen, already in the soil, available to future crops. Green manure crops that are useful when planted with taller crops are sweet clover, vetch, red clover, or alsike clover. Dwarf white clover is useful as a sod-like cover. It also has a resistance to being matted down by foot traffic, similar to vetch.

Other green manure options include:

- Planting soybeans or sweet clover before potatoes, both will work beneath corn, as does red clover.
- Between rows of root crops, plant sweet clover or dwarf white clover.
- Spring oats and spring barley will offer soil protection through the winter, and die off before spring.
- Winter wheat and rye can withstand the winter months and may be seeded in the late fall.
- Soybeans can help protect potatoes from scab, when planted as a preceding crop.

There is an extensive selection of green manure varieties and, further, they can be planted in combination, integrating their influences and effects into one planting suited to your specific growing area.
www.sustainable-gardening-tips.com/companion-planting-vegetable-list.html

5. Composting

Composting has been an integral part of farming throughout recorded history because it accomplishes two essential tasks: dealing with farm waste products and producing a soil amendment that enhances crop production. The breakdown of dead plant and animal materials is a natural process that is happening all around us. The act of composting is, essentially, monitored decomposition. In the process, bacteria and fungi alter the organic material to make it usable for plants. The ideal compost creates a stable, nitrogen–rich, pH balanced mixture of dark, moist material ready to be incorporated into the growing area.
- *Homesteading In The 21st Century. George Nash and Jane Waterman, p. 163*

You can buy compost in bags or by the truck load from local farm and garden supply stores including Greencycle (www.greencycle.net), Indiana Mulch (www.indianamulch.com) and Tiffany Lawn and Garden (www.tiffanylawnandgarden.com) or make it yourself from a mixture of natural materials such as decomposed food scraps, grass trimmings, plant stalks, leaves, wood chips, saw dust, straw, and horse or chicken manure. Material for compost can be obtained from a combination of local sources such as your own kitchen, restaurants, neighbors, and friends. It is advisable to keep perennial weeds, pesticide treated material and diseased plants out of your compost. Most every other form of plant material is fair game. All manure must be completely broken down before it is incorporated into a soil that will be planted immediately with a food crop. Some materials, such as wood chips, may take up to a year to break down. (or longer, depending on the type of wood and thickness of the actual chip), at which time they are ready to be incorporated into the soil.

The quality of your existing soil is the primary consideration in determining whether or not adding compost is necessary. If your soil is relatively low in organic matter and available nutrients, the addition of compost will go a long way towards boosting productivity and long-term soil health. Beds that are continuously cropped will need regular applications of compost to maintain balanced levels of organic matter, whereas beds where green manure crops are part of a rotation may not need additional compost.

The Composting Process
In a compost heap, organic materials containing carbon and nitrogen in the ratio thirty parts carbon to one part nitrogen are mixed together. The raw compost will transform into a much smaller pile of humus. The nutrients originally present in the mixture remain in the humus, but in a form that can be easily accessed by plants. The amount of time that this decomposition process takes can be manipulated by using different composting techniques.

Hot/Active Composting
The easiest way to build compost is to designate a spot in, or near, your growing area and form a heap. As material is accumulated from the various sources add it to the heap. This is known as 'passive' composting. To speed up the decomposition process build the heap in layers, covering each addition of chopped food scraps or manure with a layer of chopped straw, grass clippings, shredded leaves, shredded plant stalks, woodchips or sawdust. This will help insulate the center of the heap allowing it to stay warm. This heat is what

stimulates the decomposition process and helps to kill most unwanted bacteria. At the center of the heap temperatures of more than 120 degrees Fahrenheit can be reached. Most forms of composting, such as this, are *"hot"* composting methods. This process is maximized when the right balance of carbon and nitrogen materials, roughly 30/1, are layered together, kept moist, and turned every two to three days until cool. This process takes more monitoring than passive composting, but can reliably result in finished compost within a month of 'active' composting time.

Composting bins can be used when farming in urban areas where neighbors may be exposed to the unsightly, odorous heaps and can also help prevent unwanted animal-pests from infiltrating the growing area. Multiple bins can be used in unison, maintaining one for a raw stockpile of material, another for an active pile, and another for the finished product. It is common to use wood pallets, used in the freight industry, to contain three sides of a compost heap. The fourth side is left open for access to the pile. Composting bins are sold in many designs, all having their own set of pros and cons. Some roll and make turning easier, but might make it more difficult to access the end product. Others end up being homes for critters and foraging pests. You may need to experiment a little before you find the method that best suits your needs and situation.

Cold/Passive Composting

Cold composting is a fungal process (instead of the process of bacteria as in hot composting) and requires a different mix of materials and different management than hot composting. The Carbon to Nitrogen ratio is different: 60/1. Fungi require a diet high in complex carbon compounds, or woody material. This includes wood chips and dry stalks from crops. These are moistened, mixed, and piled just like a hot pile but take longer for the fungal population to reach the point at which the maximum temperature of the pile is reached. This maximum temperature should be approximately 10 degrees F above the air temperature. Piling fresh wood chips from live trees will mean a faster and higher initial temperature. This is caused by bacteria flourishing until the easily metabolized sugars and carbohydrates are exhausted, then the temperature will slowly drop. Managing a cold compost pile is much simpler than managing a hot pile. Management consists of monitoring the temperature and adding water occasionally. When the temperature of the pile drops to the air temperature, it usually means that the pile is too dry. Adding water should cause the temperature to increase again slowly. The pile is finished when its contents are dark brown to black and mostly broken down.

Vermicomposting

Vermicomposting uses worms to decompose the material. Worm beds are constructed to contain the material and worms. The worms produce high quality compost that contains plant nutrients through their excrement, which is known as "worm castings." Using worms to compost requires an investment of time, money, and skill development. Initial cost includes beds, worms, and protective coverings. The worms thrive in cool, damp, and dark environments and will breed most successfully when these conditions are maintained. They will tolerate temperatures from 40 F to 80 degrees F. This means when temperatures exceed 80 degrees, some type of shade must be provided. When temperatures are 40

degrees, the beds should be enclosed in a heated shelter. For this reason, most commercial worm composting operations are indoors.

Bedding in a worm bin is both the living medium for the worms and a food source. Material that is high in carbon is used as bedding, mimicking the worms' natural habitat, the forest floor. The bedding needs to be moist (often described as having the consistency of a wrung-out sponge) and loose to enable the earthworms to breath and to facilitate aerobic decomposition. A wide range of bedding materials can be used, including newspaper, sawdust, hay, cardboard, or peat moss. The worms can be fed a variety of available materials from manure to crop residues. Any coarse material added should be shredded to encourage rapid breakdown.

Using Compost

Compost is primarily used as a soil amendment to increase or maintain the organic matter in the soil. Another use is to prepare "compost tea" for use in a sprayer.

- *Soil Amendment.* Finished compost added to the soil maintains or increases the amount of organic matter, depending on the amount used. It also adds to the diversity of the soil life and provides food for the soil microorganisms. Contrary to most advice on the subject, compost should be added to the surface of the soil. The action of tilling in or mixing compost into the soil can do more harm than good. The mixing action harms the soil in two ways. The first is through the destruction of any existing structure that has been built by the soil life. The second is that the mixing action introduces an abundance of oxygen. This stimulates a population explosion among the bacteria. The bacteria feed on the foods present, resulting in a net decrease in soil organic matter. The mixing action also kills off beneficial fungi. This is especially important to avoid when adding compost to soil used for herbaceous plants that are dependent on a fungal-dominated soil community. The soil life will be able to utilize any food spread on the soil surface and incorporate the organic matter into the soil, working from the surface downward. This is the way it happens in nature. The plant and animal debris accumulates on the surface and is used as the soil structure and quality is improved from the top down.

- *Compost Tea.* Compost tea is a liquid extract of compost made by "brewing" compost in a container with water for three to seven days. Chemical-based pesticides, herbicides, and some synthetic fertilizers kill a whole range of beneficial microorganisms (along with the non-beneficial), whereas compost tea improves this microbial life. It is used to suppress foliar fungal diseases and can be added directly onto the plant and soil surface as an inoculant to increase biodiversity. By inoculating the area with beneficial microorganisms, compost tea encourages the beneficial microorganisms already present in the soil and on plant surfaces, instead of destroying them.

  Compost tea contains the soluble nutrients extracted from the compost, but also all of the species of bacteria, fungi, protozoa and nematodes which might exist within

the compost. Therefore, making sure that only beneficial species are present in the compost is critical. Additives are included as "food" for the bacteria or fungi present in the tea. Sugars, simple proteins, and carbohydrates can be added to a bacterial tea, while more complex foods, such as plant material (oatmeal, soybean meal and flour) can be added as food when a fungal tea is desired. The key to producing high quality compost tea is keeping the oxygen content of the brew high to promote the growth of aerobic microorganisms. This can be done using a purchased mechanism or by constructing one from common materials. It should be used within 24 hours after brewing and can be applied directly to the plants and soil. Compost tea also increases foliar uptake as beneficial microorganisms increase the time stoma stay open, while at the same time reducing evaporative loss from the leaf surface. www.georgiaorganics.org/Curriculum/Unit%206/LessonText.doc

Detailed instructions on brewing compost tea can be found at: www.finegardening.com/how-to/articles/brewing-compost-tea.aspx

6. Seed Selection and Crop Planning

There are a number of factors to consider when selecting seeds for the upcoming growing season. Not only will you need to know what you want to grow but also what type of seed to use: open pollinated seeds or hybrid, local or non-local. These topics have many details that can allow you to customize your garden or farm, enabling you to save your own seeds, have disease resistant plants, or cultivate plants that have been bred to your specific climate. This section we will go over open pollination, hybrid, and local seeds so that you may be more equipped to make decisions.

Open Pollination
Open pollinated seeds are ones that can be pollinated naturally without human intervention. There are two ways these seeds can reproduce: through cross pollination between two plants by insects, wind, water or animals, or self pollination between male and female parts on the same flower. Open pollinated seeds often have "true to type" offspring which means the offspring will resemble the parent plant keeping the genetic composition stable and allows seeds to be saved from one year to the next. Saving seeds is one of the best features of open pollination. If done correctly you can save money by reducing the need for future seed purchase, you will know the type of plant you will be getting the next year, and you can help keep that particular seed from extinction.

Hybrid
Hybrid seeds are created by cross-pollinating two different, but compatible, varieties in order to achieve a particular desired trait. These seeds can be bred to work well in marginal soil or varying climates, even to possess resistance to particular diseases. Because the second generation of a hybrid seed will revert back to the original variety, seed saving is not an option. Seed savers have found ways to stabilize some hybrid seeds so they can be openly pollinated, but it takes several generation of performing the same cross from the same original varieties. Because of this, there are a handful of hybrid varieties that are also considered openly pollinated.
www.garden.org/subchannels/care/seeds?q=show&id=293&page=2

Local and Non-Local Seed Sources
There are multiple reasons to purchase locally-sourced seeds. First, the seeds will be adapted to your regional climate, season length, and general soil characteristics. Second, buying local seed supports seed savers in your area, keeping a diverse and healthy seed supply for your region. Nature's Crossroads in Bloomington, Indiana is the best source available for seeds adapted to the climate of Central Indiana (www.naturescrossroads.com).

It might not be possible to source all of your seeds locally. Here is a short list of seed companies located outside of Indiana that Big City Farms has used, with success, over the years.

- Seed Savers Exchange – Iowa (www.seedsavers.org)
- Fedco Seeds – Maine (www.fedcoseeds.com)
- Johnny's Selected Seeds – Maine (www.johnnyseeds.com)
- Seeds of Change – California (www.seedsofchange.com)
- Baker Creek Heirloom Seeds – Missouri (www.rareseeds.com)
- Territorial Seed Company – Oregon (www.territorialseed.com)

When to Buy Seeds

When selecting seeds, be prepared to order early. Seed companies will start sending out their catalogs in the winter for spring and summer plantings. You can order fall seeds during this time, or you can wait until early spring. The first information you will see on a seed packet is typically the type of plant, a picture, the cost, the seed company's name, and possibly some information on what type of seed it is (hybrid, open pollinated, organic, or heirloom). Below is a list of items that should be on a seed packet and in a seed catalogue. This information will help you create a planting calendar.

- Description of the plant (sometimes, even in it is different stages)
- Cold season or warm season plant. (spring and fall plant, or summer plant)
- Instructions on how to plant (when to start, indoors or outdoors, planting depth)
- Germination temperature and number of days to germination
- Days to maturity (number of days between seed planting and harvest)
- When and how to transplant
- Spacing and thinning
- Location (for optimal light and proper soil)

Crop Plan

Planning is critical to any business, and especially for a diversified farming operation. We all know that weather and temperatures dictate what can get done in the field, but a good plan will allow you to make adjustments as needed. Planning is a cyclical process, and by comparing what actually happens back to your plan you are able to make adjustments in order to improve future production.

A crop plan is essential for creating and maintaining efficiency and timeliness in order to meet harvest goals and provide a greater diversity of produce each week to your market throughout the season. It should give you an idea of what needs to be prepared, seeded, transplanted, and harvested. Any cover crop seeding and management should be incorporated into this plan as well.

Basic Considerations when Developing a Crop Plan

A map of your farm is a good thing to have, and a fine place to start making your crop plan. The Natural Resource Conservation Service will provide you with an aerial digital map of

your farm and digitally outline your fields.
www.georgiaorganics.org/farmers/CropProduction/CropPlanning.aspx

Other questions to consider are:

- What types of crops will be grown?
- What part of the season is the ideal growing period for these crops?
- What is the total number of plants required each week (if applicable) to supply the amount of produce necessary?
- What is the total number of plants required for the season?
- Will the crop be transplanted into the field or direct seeded?
- Using the beds available, how can I most efficiently arrange successive plantings, determined by the rate of maturity for the specific crop?

Advanced Considerations of Developing a Crop Plan

After your farming operation is successfully established, you may consider some of the following questions:

- How much of each crop (in pounds, bunches, heads, etc.) do you need to harvest and how frequently?
- Is the yield storable and distributed incrementally over time? (For example: potatoes, garlic, onions, winter squash, dry beans, some varieties of tomatoes.)
- Is the crop to be planted in successive pattern, requiring regular and repeated sowings to ensure a continuous supply? (e.g. lettuce, broccoli, cabbage, cauliflower, celery, leeks, Asian greens, carrots, beets, spinach, cilantro, radishes, salad mix, arugula, bush beans, and corn)
- Does the crop have an extended harvest period? (e.g. strawberries, summer squash, green/red peppers, basil, cucumbers, fresh beans, chard, kale, collards, some varieties of tomatoes)
- What are the first sowing date and last harvest dates possible based on climate? (e.g. soil and air temperatures). This will determine the first distribution day and the possibility of a season extension.
- How many days (on average) are required for the crop to reach maturity?
- What is the appropriate timing/frequency of sowings? Each successive sowing date should allow
  for a small overlap in the peak harvest period to allow for an uninterrupted harvest.
- What is the total number of sowings needed for each crop for the season?

Crop Planning Software

Although it is not necessary to use computer software to help make a crop plan, it may be useful and options can be found at:
www.code.google.com/p/cropplanning
www.georgiaorganics.org/ForFarmers/CropProduction/CropPlanning/CSACropPlanning.pdf

7. Seed Starting

The working definition of seed starting here simply means starting fruit or vegetable seeds in trays and transplanting into the ground once the plant has reached sufficient size. When considering seed starting, a farmer should ask themselves two initial questions. First, given the size, scope and infrastructure of the farm is it better to start seeds or purchase transplants from another grower? Second, if starting seeds, what types of plants will the farmer need and what number of each type of plant will be needed to execute the type of growing planned? Once these two questions are answered, the picture will become clearer regarding if/how to start seeds.

Seeding/Planting Calendar

Every farm, no matter the size, should have a detailed calendar which outlines the dates the farmer plans to start, transplant and direct seed all crops for the entire season. This calendar is best developed in the winter (when there is more time for such activities) so that during the growing season the farmer can rely on a well-planned calendar to remain proactive. Farming is inherently reactive, so the more planning each grower can do in advance the more frustration will be avoided. Of course, the calendar will need to be adjusted year to year based on conditions and observations, but over the years the farmer will be able to define their growing calendar to best fit their needs. **An example of the Big City Farms planting calendar can be found in Appendix D.**

Seed Starting vs. Transplanting

In the long term, it is likely more cost effective for farms to start their own seeds. However, in the short term this will require infrastructure development (all of which will be addressed below) and will increase the farmer's growing season by several weeks (i.e. – in many cases, seeds must be started six to eight weeks prior to the first direct seeding of the season). Each farmer should decide for themselves in the short, medium and long term the benefits of starting their own seeds versus purchasing transplants. There are several farmers in central Indiana who have large seed starting operations and start seeds for smaller farms in the area. For those needing to buy transplants, this is the preferred arrangement, as it keeps farming dollars in the local community and allows the purchasing farmer to work directly with the seed starting farm to grow preferred varieties.

Determining Number of Plant Starts

It is prudent for farms to develop a crop map each year, which plans and outlines specific beds throughout the growing season. This allows the farmer to determine (more or less) the number of plants starts he/she will need of each crop. For example, if a farmer plans to grow 500 row feet of tomatoes and knows that spacing should be 24 inches between plants, the farmer should plan to start at least 250 tomato plants **(a vegetable planting guide is included in Appendix E and shows appropriate spacing for most vegetables grown in the area)**. Farmers should plan for at least 10% more starts of each type of vegetable, as some starts will die in the pot or in the ground, and extra plants will allow the farmer to fill in gaps. In addition, the farmer could start even more plants to sell to other local farmers or gardeners, or at farmers market. Plant starts tend to sell well at market

and this provides the potential for early season income for the farm. Plants starts, depending on type, will sell from between $0.50 and $4.00 at market.

Many vegetable and herb varieties can be started or direct seeded and the farmer should determine his/her preference on starting versus direct seeding each varietal they are growing. Starting seeds gives a significant jump on the growing season, but also requires additional time and materials. We encourage growers to sample with both starting and direct seeding the same varieties to determine their preference and how each method is impacted by their growing conditions.

Potting Mediums

Seeds should be started in a potting medium rather than soil, as potting mediums significantly lighter, retain ample moisture and typically have the nutrient and material balance that are most amendable for seeds in pots. For convenience, many farmers will purchase pre-mixed potting medium at garden or farming stores. We have found Sunshine Organic Potting Medium to be quite effective. It is available locally at Carl Brehob & Son (3821 Brehob Road, on the near southside of Indianapolis). Some farmers will mix their own potting medium and Eliot Coleman, a highly-respected organic farmer in Maine, has created a commonly used homemade potting medium that includes peat, lime, sand or perlite, blood meal, collodial phosphate, greensand, soil and compost. Creating one's own potting mix can save money in the long term and also allows farmers to tweak their potting mix over time to respond to their specific growing conditions.

Seeding Trays and Soil Blocks

Farmers will need to decide the best set-up for their seeding operation and one decision that needs to be made is whether to use seed trays (called cell trays from here forward) or soil blocks. Cell trays tend to be 10"x20" but have different sized cells to accommodate as few as 36 plants per flat to as many as 200 plants per flat. Of course, a greater number of cells will result in a smaller amount of potting medium in each individual cell. The advantage of cell trays is that they allow for a large number of plants per tray. The disadvantages are that they need to be watered very frequently and are made from plastic that can be easily damaged. However, if a cell tray is treated carefully it can be used for several years.

An alternate to cell trays is a soil block maker (or soil blocker), which is essentially a soil mold that compresses wet potting medium into its own cell. Soil blockers come in various sizes, as small as ¾" per block to as large as 4" per block. The advantages of soil blockers are that they only require a seed tray to hold the blocks, but without any additional plastic. In addition, soil blockers are made almost entirely from metal and could last for decades. The disadvantages of soil blocking are that in order to get the block to hold together, the potting medium needs to have the appropriate moisture level (a process that takes some trial and error) and soil blocking will require much more potting medium than using cell flats.

In order to assist with seed germination, some farms will utilize seed starting domes (plastic hoods that cover the top of the tray and help to retain moisture) and heating mats (electric heating sheets that are placed below the seed trays). Though both are useful to assist with germination and growth, they can be rather expensive (particularly heating mats) and are typically only used by those with smaller seed starting operations.

Seed starting supplies are available from many places. Carl Brehob & Son (3821 Brehob Road) is an excellent source for potting medium, trays and greenhouse hardware. Johnny's Selected Seeds (www.johnnyseeds.com) also has a wide array of options.

Grow Lights

In order to get a jump on the growing season, some farmers will begin starting seeds indoors under grow lights in mid-winter. For example, in central Indiana, onion, leek and scallion seeds can be started inside in early/mid-February before being transplanted outside in mid-April. Indoor seed starting has the advantage of a controlled environment that allows for temperature regulation and consistent watering. However, indoor environments can sometimes result in mold and fungus problems on plant starts, so growers should check their starts regularly for diseases. If you notice extreme problems with mold or fungus, a hydrogen peroxide spray on effected plants is a sound organic treatment.

Grow lights can take many different shapes; typically, they contain four-foot long fluorescent light tube pairs. Farmers seed trays in their preferred manner and then place seed trays under grow lights. Lights should be placed on a timer, with about eighteen hours of light per day and six hours of dark. In addition, lights should be placed as close to the soil level as possible (within one to two inches is best at the start). Small starts tend to stretch quickly to their light source, and the farther the light is from the soil the more "leggy" (a term used to describe tall plants with weak trunks) plants will become. This is a problem because when it comes time to transplant, the start will not have the strength to hold up to wind and other environmental factors. Grow lights should be able to move up and down; as plants grow, the lights will need to be adjusted so as to keep the plants from touching the actual light bulbs.

Hoop Houses and Greenhouses

Many farmers elect to start plants in hoop houses (unheated greenhouses with plastic stretched over hoops) or greenhouses. For farmers who are not trying to stretch their growing season as far as they possibly can, starting seeds in one of these structures tends to work well. The primary benefit of such a system is to avoid the costs associated with an indoor seeding operation.

Watering

It is important to neither over nor under water plant starts, an obvious challenge for new farmers. Overwatering can yield high levels of mold or fungus and sometimes even drown a plant, while under watering causes plants to become parched and die. A general rule of thumb is to allow the potting medium to dry almost completely before watering again, which can be determined by looking at and feeling the bottom of the tray. Perhaps the most

important tip we can offer is to water deeply less often instead of lightly watering every day. For convenience in watering, it is best to grow as many plants as possible in the same size cell or soil block so that all plants will more or less moisten and dry on the same schedule.

Fertilizing

Pre-made or homemade potting medium will typically have a solid nutrient balance; however, young plants might require additional nutrients to become established, survive and thrive. There are many options for fertilizing plant starts, and sustainable farmers tend to use fish emulsion, worm castings and/or compost tea. We encourage new farmers to try various fertilizers to see what works best for them in their farming operation. In general, fertilizers should be applied while watering and fertilizing once every seven to ten days should be sufficient. If you notice signs of a lack of nutrients, often by extremely slow growth or leaf discoloration, increase fertilizing in the short term to help plants recover. Paying close attention to the health of starts should pay strong dividends, as the healthier the start is the healthier the plant will be once it is in the ground.

Potting Up

Potting up is a term that describes moving starts to larger containers as they increase in size. Depending on the amount of time until the plant will end up in the ground, farmers may need to pot up plants one to two times. Although potting up requires additional materials (e.g. – larger pots and additional potting medium) and time, there comes a point when plant starts become so over sized and root bound in their block or tray, that the farmer will lose their starts if they do not take this step.

Hardening Off

As the time arrives to start transplanting, farmers will need to "harden off" their transplants. Whether under lights, in hoophouses, or in greenhouses, plant starts tend to live a charmed life. They receive regular doses of fertilizer and water, and are out of the wind and driving rains. Hardening off plant starts simply means gradually introducing them to outside conditions. Farmers will often only move their starts outside for three to four hours the first day, five to six hours the second day, seven to eight hours the third day and then leave them outside from the forth day forward. Of course, this requires a lot of extra work in the form of moving trays each day, but with the amount of time the farmer has spent working on the starts he/she can easily justify this effort. Before actually transplanting the plants into the ground, the farmer should be certain that the starts have been fully acclimated to the outdoors.

Spring, Summer and Fall Seed Starting

Many new farmers imagine that they will start seeds only in late winter or early spring. For diversified farms trying to grow through much of the year, seed starting will be a consistent activity they return to week after week throughout the season. We tend to seed spring/early summer starts each week from February 1 to May 15 and fall starts are seeded weekly from August 1 to September 1. This allows us to have a variety of vegetables maturing in the ground each week, and a further variety of vegetables maturing throughout

the growing season. **Once again, a Big City Farms planting calendar is included in Appendix D for your reference**.

8. Transplanting

There is typically a wide gap in farming between the ideal and the reality. What is meant by this here is that there is an ideal time when farmers should be transplanting in order to give starts the best chance to survive. Ideal conditions would be in late afternoon on a cool day, after a recent rain, with some rain and cloudy skies in the forecast. The reason for this is that cooler temperatures, a lack of sun, and wet soil provide the most amenable conditions for young and fragile plants. However, the reality is that sometimes transplants need to get in the ground, no matter the conditions because of time, schedule, and/or availability of labor. Farmers should monitor recent transplants closely to make sure they have the necessary water and soil conditions to survive.

Bed Preparation
It is advisable that growers completely clear beds of weeds, rake beds flat and clearly define growing beds and walking paths in advance of transplanting. These activities are recommended at this point in the growing process as there will be no plant obstructions in the way of tools and bed preparation to this extent is unlikely to happen during the growing season if it does not happen now.

Watering and Soil Preparation
Once again, to give transplants the best chance for survival, they will need plenty of water upon initial transplanting and in the first days they are in the ground. On particularly warm transplant days when the soil is dry, it is recommended that growers take a systematic approach to watering. First, the transplants themselves should be watered in the cell trays or soil blocks so that the potting medium is as saturated as possible. Second, the soil where plants will be placed should be pre-watered (by sprinkler, drip tape or hand watering) and each transplant should be "watered-in." Watering in simply means heavily watering each hole or trough where transplants will be placed in order to have as much water in that defined area of soil as possible.

Some growers will also provide plants with an initial nutrient boost at the time of transplanting in order to set them on a healthy course. In generations past, small farmers have taken on various strategies including placing a fish head in the transplant hole. A more modern version is for farmers to use a banana peal or eggshells in the transplant hole. The most common scenario these days is to place a shovel full of fresh compost in the hole as an initial amendment. Although this step is not necessary, it can be helpful, particularly on farms where the soil is worked heavily throughout the year.

Transplant Spacing
When deciding where to dig transplant holes (typically using a hand trowel), the farmer should determine ideal spacing for each vegetable variety, which will depend both on the mature size of the plants and the tools that the grower plans to use to weed around the plants as they grow in size. **A spacing chart is included in Appendix E and can be used as a guide for new farmers to determine a comfortable amount of spacing for transplants**. When growing on a small scale, it is as important to make sure that plants

have the necessary space to grow to full size, as it is to maximize growing space. Once again, the type of tools that will be used for weeding including hoes (stirrup, collinear, trapezoid), hand weeding tools or simply using hands for weeding, should be considered so that the tools can slide easily between transplants without disrupting root systems.

Final Notes on Transplanting

Transplanting often occurs during periods of the farming season when many activities are occurring and time is limited. Despite this, farmers should be well prepared to look after their transplants in the initial days. This will include deliberate watering, should the weather turn hot and dry, as well as having shade cloth on hand for the same reason. This will also include being prepared with row cover, particularly for early spring and late fall transplants, should the weather turn very cool with the potential for frost in the forecast. Row cover can increase soil temperature by as many as fifteen degrees, which can often make the difference between transplants surviving or perishing in a frost. Finally, growers should plan to have extra transplants available as inevitably some transplants will not survive (for a myriad of reasons described above) and growers will likely want to fill in gaps to maximize growing space.

9. Cultivation

Cultivating land simply means to prepare the soil for the coming crops, but cultivation includes much more. Before planting your crops, cultivating involves such things as tilling or broadforking rows, and then, after planting, it involves maintenance such as weeding, hoeing, and hilling. In this section, we will talk about when to do these types of cultivation and with what tools. We will also include pruning in this section because, like cultivating, pruning can encourage plant growth.

Timing

Never cultivate the soil until it has been tested and you know what is necessary to improve your soil.

Deep cultivation should be done only in preparation for a new crop rotation or when first building out your farm. After you have established rows, turning over the soil or cultivating deeply is primarily only used to prepare the beds for plantings or to mix in compost. It is unnecessary to cultivate before the winter because the plants will not be in the ground to take advantage of the nutrients being released. Instead, it is better to improve the soil by applying compost and mulching rows. Keep in mind that beneficial microorganisms and earthworms are at work in the soil and it is best not to disturb them.

There still needs to be some cultivation done throughout the season, but it is important to minimize excessive soil disturbance. This is achieved through surface cultivation and it is done with a rake, stirrup hoe, collinear hoe, or broadfork. The idea is to keep weeds down by cutting off their tops from their roots and doing so when they are small so as not to damage your crop roots by going deep. When a plant is finished for the season, pull it up and compost it, use a stirrup hoe to kill weeds and apply mulch for the winter, saving deeper cultivation for spring. (www.growveg.com/growblogpost.aspx?id=166)

Cultivation also includes hilling. This refers to building up the soil around the plant to protect the roots from being exposed. The best examples are with potatoes and corn. As potatoes get larger, they often start to come up out of the soil. Simply covering them with soil or mulch will prevent sun damage. Corn grows brace roots before they start producing. These are to support the stock against wind and the coming crop. Still, farmers often find that corn still has issues staying upright so they might employ hilling as a way to help. They often plant corn in a small trench and, as the stock grows, they periodically hill the plant.

No till gardening is gaining popularity and involves minimal disturbance to the soil so that earthworms, organic matter, and good soil structure can be established. It involves surface cultivation to keep the weeds down without breaking into deeper soil. Tilling the land not only disrupts the soil ecology but it also can cause too much aeration and erosion of the soil. To begin reducing your reliance upon tilling, you will need to have a good amount of nutrient-rich soil already in place, with the plan of adding to it as you use the land from year to year. Throughout the season, use surface cultivation as the plants are growing, leave spent plants to decompose in the field, and add compost and organic material when

putting a bed to rest. Some aeration may be needed and can be done with a broadfork without disturbing the soil too much. The best rule to follow is to avoid turning the soil upside down and tread lightly or not at all on planting areas. (www.no-dig-vegetablegarden.com/no-till-gardening.html)

Tools
Primary cultivating tools include:

- Stirrup Hoe - Looks like a stirrup for a saddle and moves back and forth, enabling it to work in both directions. It goes just below the soil to cut the roots of weeds but does little damage to the basic soil structure.
- Collinear Hoe (short or long handle) – Performs a similar task as a stirrup hoe by removing weeds just below the soil and avoiding any further damage to the soil. This hoe, however, does not work well in compacted soil.
- Broad Fork - This is a large horizontal bar with several metal tines attached. The tines are long and evenly-spaced along the bar. The tines are inserted into the ground and used to gently aerate the soil. Some people use this instead of a rototiller because it aerates the soil but does so in a less destructive way.
- Rototiller - This is a machine with blades either in the front or the back that rotate and dig into the ground to break it up. Tillers should only be used when building out or rotating crops as their action causes significant disruption to the soil.

Pruning
Pruning is important to encourage healthy growth of the plant and the quantity and size of fruit. Pruning means to cut off or pinch away parts of the plant to increase growth. Knowing where the active growth is on the plant will help you know where to prune. Active growth usually is at the end of the branches or vines so the buds further down the plant are waiting their turn. It is important to take off any damaged or ripe fruit so the dormant buds can start growing. Similarly, if there are extra branches or leaves those can be taken off so the plant can focus on larger and more fruit. There are different reasons and ways to prune plants so make sure to do some specific research on the plants you are growing.
(http://www.learn2grow.com/gardeningguides/edibles/caremaintenance/PinchToGrowAnInch.aspx)

10. Tools

Tools that individual farmers will need depends upon the size of the farm, the budget available for tools from year to year, and the appropriate tools needed to keep the farm operating efficiently. In addition to new tools, farmers should constantly be on the look out for used tools that fit their farming needs.

Non-Mechanized Tools

Most small-scale farms can be successfully managed with non-mechanized equipment and having an appropriate cache on-hand will save the farmer time and effort in the long run.

- *Weeding Tools* – We suggest farmers have various tools for weeding, including stirrup hoes, collinear hoes and hand hoes. Weeding tends to be the most time consuming activity on small, sustainble farms and having a variety of weeding tools at your disposal for various planting situations will be worth a small investment. We suggest that you also have comfortable gloves for weeding, as invasive weeds such as poison ivy will often find their way onto farms, and it is wise for farmers to have protection against potential irritants.
- *Direct Seeding and Transplanting Tools* – For farms whose structure is laid out in longer planting beds, a wheel seeder is an extremely wise investment. Wheel seeders allow farmers to put seeds in a hopper and seed long rows in a minimal amount of time. The most popular single row seeder on small farms is the Earthway Wheel Seeder. A more precise (and more expensive) model is the Jang Wheel Seeder, which is also commonly used. Farmers who grow many small greens or root vegetables that are planted close together may find use in purchasing a six-row seeder, which as the name implies, seeds six rows at one time. Farmers will need hand tools to dig appropriate holes for transplanting seedlings. A hand trowel works well for this purpose, and we have found that hand hoes are also useful as both a weeding tool and as a tool for digging transplant holes. Farmers who have back problems, or imagine working with volunteers who have a difficult time bending over to transplant, could consider a Hatfield Transplanter, which allows two people to transplant starts without bending over.
- *Bed Preparation and Farm Maintenance* – Farmers will need various tools to keep beds in order, and for general farm maintenance. A common set of such tools will include a spade shovel, flat shovel, stirrup hoe, hard-tined garden rake, leaf rake, post-hole digger, pitchfork, broadfork, post pounder, sledgehammer and pruner. This set of tools will be able to do ninety percent of the day-to-day activities that will be required for general farm maintenance. Of course, each individual farmer will at some point realize they are missing certain tools that will make the work more efficient, and keeping a "wish list" of such tools is advised.
- *Harvest Tools* – Appropriate harvest tools will depend entirely on the crops being grown by the farm. In general we suggest that farmers have multiple sets of harvest knives (both serrated and flat) and multiple scissors and shears. These tools can be used to harvest everything from small greens to large cabbages and broccoli. Harvest tools should be kept very sharp, and we suggest purchasing a slate

sharpener and sharpening tools regularly. For farms that focus on small greens (spinach, mixed lettuces, arugula, etc.) an investment in a greens harvester may make sense. A greens harvester allows a farmer to harvest across an entire planted bed, instead of hand harvesting with scissors row by row. Anecdotal conversations with other farmers have indicated that this tool will allow for greens harvesting in a fraction of the time when compared with harvesting with scissors.

Mechanized Tools

Farms that are located in residential areas where a certain aesthetic is expected should have (or have regular access to) a lawn mower and weed eater. Some farms will also find that they need a front or rear-tine tiller for the times of year when significant bed cultivation is required. Larger urban farming operations (one acre or more) might consider the large investment (multi-thousand dollar) in a walk-behind tractor. A walk-behind can replicate many of the functions of a traditional tractor on a small scale, and have a wide variety of attachments for various functions (including tiller, hiller, mower, chipper, shredder, etc.). Walk behind tractors can allow a small farm to significantly increase efficiency. Of course, this comes at the cost of an initial investment, regular purchase of gasoline and general on-going maintenance.

Final Thoughts on Tools

If the urban farm model the individual farmer plans to develop will involve interns, apprentices and/or volunteers, it is wise to have multiple sets of tools that can be used by all farm labor. This will require an additional capital investment, but the cost savings of labor and correct tools will save the farm significant time and money in the long run. We urge growers to be realistic about the amount of additional labor their farm can anticipate and plan tool purchases accordingly.

We suggest future farmers spend time browsing through the tools sections of many seed catalogs and farm supply companies. We also suggest potential farmers visit other urban farms in Indianapolis and the region to discuss tool use, and perhaps trial various tools used by other sites. Fellow growers tend to be quite willing to share the advantages and disadvantages of the various tools on their farms as well as provide suggestions on other tools they would find useful for their farming operations. Tool procurement can be a significant investment, even for small-scale operations, but as the farmer gains experience he/she can start to see how smart purchases of targeted tools will save time and effort and increase productivity and efficiency.

11. Insects

In popular imagination, insects are merely viewed as creatures that should be banished from any and all gardens, as they are surely out to wreak havoc. Fortunately, this viewpoint has begun to slowly erode with an increased understanding of the intricate and valuable role that insects play in a healthy, balanced ecosystem – something that any farmer should strive for.

The Role of Environmental Stress
It has been widely demonstrated that applied environmental stress will predispose plants to a heightened susceptibility towards diseases and insect damage. This is accomplished by substantial changes that occur in plant physiology due to drastic changes in water supply, excessive heat, or insufficient nutrients. Similar to humans, plants have a built-in immune response system that allows them to successfully confront potential threats to their well-being. When a plant is able to adequately meet all of its nutritional, water, and light needs, it is better prepared to deal with insects and diseases. For example, when plants experience even moderate levels of environmental stress, the chemical processes that naturally occur within plants are disrupted, making the plant more palatable to some insect populations.

Chemical Responses to Stress
These sorts of chemical changes can work in a plant's favor, assuming that it is in a sufficiently healthy state when its leaves are eaten by herbivore insects. Plants are actually able to emit volatile chemicals that act as phytodistress signals. These chemicals are released in order to attract parasitic and predatory insects (beneficial insects) that are natural enemies of the herbivores. This is just one example of the sophisticated immune response system that healthy plants possess and are able to employ when they are not excessively stressed by their immediate environment.

Plant-Focused Approach
There are a variety of ways to encourage the natural, biological defenses of plants to potential insect damage. The most basic ones focus on ensuring that a plant has sufficient water, sunlight, and food. This sort of direct action is achieved through careful cultivation of healthy soil that possesses ample nutrients and organic matter for water retention capabilities. This also means to avoid over-crowding of plants so that their leaves are able to receive ample sunlight, their roots are not competing for limited water supplies, and their stems and leaves have ample room to spread and grow.

Systems-Focused Approach
A more subtle approach to improving plant health and limiting potential insect damage is to focus on the structural and biotic diversity of the growing space. This involves planting different vegetable varieties and species in order to create a polycultural environment. This sort of ecological diversity accomplishes a wide range of goals that are beneficial to overall plant health. It can increase the available microhabitats within a given space, allowing the farmer to address a specific variety's needs more fully. The diversity also

complicates the chemical cues that herbivore insects depend upon to find food sources, disrupting their foraging instincts. Lastly, polycultures improve the stability of a sustainable predator-prey relationship between insects.

There are certain plants that are attractive to beneficial insects, and which can be used to help maintain a sustainable growing operation that does not suffer from excessive insect pressure. An excellent resource on increasing on-farm biological diversity in order to attract beneficial insects is "Farmscaping to Enhance Biological Control:" www.attra.ncat.org/attra-pub/summaries/summary.php?pub=145

Mechanical Control of Insects

Big City Farms employs ecologically sensitive methods of pest control when insect damage becomes noticeable and significantly decreases the likelihood of successful harvests. The approaches vary from species to species, but are intended to impact the land in the least intrusive way. For example, when aphids become a notable presence on plants, they are sprayed off with a high-pressured blast of water. This action knocks the aphids off the plants and disables the attachment mechanisms they might use to return to plants. Another example is hand-picking cucumber beetles from cucumber and squash plants. This is done in the early morning, when the bugs are most sluggish. Although this method is labor-intensive, it can be employed successfully when cucumber beetle populations are at a minimum.

Lightweight row covers can be a useful preventative tool in addressing potential insect pressure. This breathable material is placed over young plants to provide a physical barrier to insects. It is often used with squash, cucumber, and arugula plantings. Kansas State University has compiled an excellent plant problems/pest resource: www.hfrr.ksu.edu/p.aspx?tabid=586

Growing vegetables without the use of chemical insecticides requires the grower to be especially vigilant to the soil health, changes in plant physiology, and the presence of insects, both herbivorous and beneficial. This increased level of attention should be viewed in a positive light, as it encourages the grower to be more attentive to the overall health of the farm's ecosystem and the ways in which that ecosystem can expand and contract.

12. Harvest/Storage

Timing
Harvesting is a very encouraging time. Finally, there is tangible proof of your hard work! Because fruits and vegetables have different varieties that should be planted at different times, they will also be ready to harvest at different times. Vegetables like root crops and leafy green crops will be ready in the cooler weather, and vegetables such as peppers, squash, tomatoes, and others will be ready in the warmer season.

The best way to make sure you are harvesting at the correct time is to make a harvest plan. You should already have an idea of what you will be growing and a planting calendar to work with through the season. With that information, you should have an approximate time for harvesting particular crops. You could also look up a specific crop to learn what the plant should look like when it is ready to harvest.
Kansas State University has an excellent guide to harvesting:
www.ksre.ksu.edu/library/hort2/mf661.pdf

Harvest Supplies
Before you go out to harvest your crops, think about the type of supplies you might need. Each plant will have a certain way to harvest to keep production going, so make sure to check seed packets. Some fruits and vegetables are simply plucked from their plant but others require clippers or harvesting knives. Here is a short list of the supplies you might need while harvesting:

- Harvest knives (for plants such as fennel and bok choy)
- Small clippers (to clip herbs and greens)
- Shovel (for root crops)
- Crates or containers (to store harvest)

Post-Harvest Treatment
It is important to know what to do with crops immediately after harvesting. With correct treatment, produce will stay fresher and last longer. Usually post harvest treatment involves cooling down, washing, and in some cases, making sure there is sufficient water for the produce to stay crisp.

When harvesting in warm weather, it is critical to cool the harvest down immediately. For example, greens, roots, herbs, and other such plants do well in warm weather while still attached to the plant, but once they have been harvested they can wilt quickly. It is ideal to wash and store in a cooler, but if that is not available, have cool water in which to dunk and store them until you can get them to a permanent cool location. Make sure the root or stem part of the plant is set into the water so wilting can be avoided. Also, allow enough room in the storage container so that the vegetables are not crushed, keep them out of the sun, and plan your harvesting as close to the time you will be passing the produce onto the customer. These steps are necessary to accomplish the goal of fresh, quality, and clean

produce for your customers.

In colder weather, washing and providing water is just as important even though there is less risk of wilting. It is also a good idea to wait for frost to thaw before harvesting. Cold-hardy plants such as broccoli, cabbage, and kale will be fine to harvest with a little bit of frost, but by waiting you will give the plant time to revive itself from the heavy frost. The plant may look like it is done for, but you will be surprised how they come back as the day gradually warms.

Post-Harvest Supplies

Once the harvest is clean, you may need to bunch or bag some items. It is easy to forget to plan for these supplies but it is important to always have them on hand. Here is a small list of what you might need and their uses:

- Bags and twist ties (for lettuce and salad mixes)
- Rubber bands (for bunching greens and herbs)
- Scale (for weighing your portions)
- Boxes or coolers (for transporting and storing)

A goal of visually appealing crops should be an important post harvest consideration. Though cleaning and cooling are the most critical, the way your harvest is bunched and the quality of presentation should be considered at this time as well.

Things to consider include:

- Do you have all the crops and supplies you need?
- How is the quality?
- Are your bunches and/or bags of equal weight or volume?
- Are bunches and/or bags neat, put together and have enough room to prevent crushing?

Storage options

Once you have cleaned and cooled the harvest you may need a place to store the items until the produce gets to the customer. Not all farms have the luxury of a large or walk-in cooler, which is ideal for storage. Some farmers find refrigerators or other smaller coolers to work with and others use ice coolers and ice packs for storing (these are good for transporting as well).

Just as each plant has specific instructions on planting, caring, and harvesting, each plant harvest has a different way for storage. For example, lettuce should be stored clean, somewhat dry, and in a cooler while potatoes and onions should be stored in a dry, dark place, that is cool (50° to 60°). With that in mind, you should know the storage needs of your harvest and plan accordingly.

13. Distribution and Marketing

Whether for-profit or non-profit, all farms and farming projects need a detailed plan for distribution of produce to be able to maximize production and minimize waste. Before embarking on any farming operation, we highly recommend that the farmer consider all their distribution and sales channels before settling on a final plan. It is absolutely essential that a model is selected that allows the farmer to be able to maintain and advance the farming operation, and have the time to distribute produce and develop relationships with customers. In any business or initiative, the best customer is the return customer. Finally, the farmer must be aware of utilizing a sales model that will allow for a healthy work/life balance, a piece that is often forgotten or ignored by farmers.

Community Supported Agriculture (CSA)
The CSA model was developed in Germany, Switzerland and Japan as a response to food safety and the limiting of agricultural land, and was brought to the United States in the mid-1980s. The model of a CSA involves a farm recruiting "members" or "shareholders" who pre-pay for their seasonal vegetables in advance and are provided with a box or bag of produce during consistent intervals throughout the growing season. In the Midwest, CSAs typically run from between 15 and 25 weeks with produce pickup happening one time each week. A good rule of thumb for small growers practicing intensive planting is 25 CSA shares per acre. Of course, this can vary widely and we encourage farmers to initially plan a CSA number that easily fits within their growing space.

CSA farming models have many advantages, perhaps none more than providing the farmer with the initial financial capital to begin the growing season, as well as a guaranteed income to be spread throughout the year. CSA members will typically sign an agreement stating they understand that farming is an uncertain industry and will share in the "risk" by accepting that there could be droughts, crop failures and bug/pest pressure. Of course, CSA members also share in the "reward" during years in which crop yields and quality are particularly high. CSA farming also has disadvantages, in particular the necessity for a very detailed crop plan so that produce is consistently available throughout the CSA season. CSA farming can also come with some amount of pressure, in trying to provide members with value for their investment throughout the growing season. For this reason, some CSA farms will occasionally purchase product from other farmers whose farming practices are well aligned with their farm during weeks of particularly thin harvest. Furthermore, the CSA model puts a large administrative burden on the grower and typically includes a weekly newsletter with recipe(s) and email correspondence with members. Many CSA farms will also have a social media and web presence to keep members updated. We have heard of CSA models that trade a CSA share for administrative assistance and each farmer should calculate if such a trade is cost effective for their operation.

For new farmers considering the CSA model, we recommend starting out with a shorter CSA season and/or a smaller number of CSA members to give the best chance for success during the first growing season. It will be much easier to increase the size and scope of a CSA year to year versus running a CSA that is too large for the size of the farm. It is wise to

keep a CSA tracking form each year so that farmers can easily look back at what was included in their weekly share each week. **Examples of Big City Farms CSA Tracking sheets are available in Appendix E.**

Farmers Markets

The popularity of farmers markets has increased exponentially over the last few decades and farmers markets can now be found on most days of the week around greater Indianapolis. When considering attendance at a farmers market, the grower should consider many factors including: attendance at summer and/or winter markets depending on crop varieties, location of the market, day of the week of the market to be able to accommodate harvest schedule, whether or not the market is grower/producer only (this implies that farmers can only sell products they grow/produce and not resell for other farmers/producers), and the number of vegetable growers at a particular market (e.g. – being one of few vegetable farmers at a small farmers market, versus one of many vegetable farmers at a large farmers market).

We encourage new farmers to shop at farmers markets they are considering attending several times to get an understanding of the type of customer in attendance, the type of products available and the number of customers who attend week to week. One of the major challenges of farmers market sales is determining how much product to harvest and bring to market each week. Of course, farmers want to take as much product as possible to maximize sales, while at the same time not taking too much as to minimize waste. Some farmers market (or individual farmers) will take unsold produce to food pantries or to Second Helpings (a food rescue non-profit located downtown) and can often receive a tax deductable donation form for the value of the produce.

Restaurants/Groceries

The increase in locally owned restaurants and groceries purchasing from local farmers has been steady and profound in recent years. Though chefs and shop owners can often purchase the same non-local produce from large distributors at lower costs, they are increasingly valuing the freshness of the product, the connection to local farms and the decreased carbon footprint of local distribution. In addition, it becomes a good marketing tool in a competitive restaurant world to promote a connection to local farms and farmers.

A major benefit of this type of distribution model is that the farmer can harvest the exact amount of product that the restaurant needs in a given day/week without any waste. A disadvantage is that there is an increasing number of farmers focusing on distribution to locally owned restaurants and groceries, so the market is becoming more competitive and, as such, product prices may be declining. We highly recommend that growers try to connect with chef and shop owners whose businesses are close to their farm and discuss what types of produce they would like grown for their establishment. We tend to meet with all our chef contacts each winter to summarize what they bought during the previous growing season and plan what to grow during the following growing season. This personal connection and personal service takes a lot of time, but results in a higher level of interest and investment by the chef or shop owner. It is worth stating again, the best customer is the return customer.

Farm Stand
Farm stands are a unique opportunity for distribution, particularly for urban farms located in neighborhoods as they can access regular customers passing by car, bike and foot. The farm stand model is very straight forward, with customers coming to the farm site at prescribed hours to purchase produce. We have seen farm stand models where farmers will pre-harvest produce much like a farmers market, and other models where farmers will wait until customers arrive to the farm stand and harvest specifically to their order. Of course, the latter model is predicated on the farm stand and farming operation being in the same place. A secondary advantage of a farm stand distribution model is that it allows the farmer to continue to work during their distribution period. With limited hours during the week, any additional time being able to maintain the farm will be useful.

Pick Your Own (U-Pick)
U-Pick farms typically exist in rural areas as they typically require a lot of land, which is limited in urban areas. Nonetheless, a portion of a farm set up for U-Pick could be an interesting option for some farmers. A few factors should be considered in this model, the first being that the farmer will have to demonstrate to shoppers how to harvest particular crops. Second, for U-Pick operations to be profitable, farmers should focus on renewable crops (i.e. – crops that are not one time harvest like root vegetables). Possibilities for such an operation include peas, beans, kale/collards/chard, cherry tomatoes and okra, just to name a few. Watermans Farm Market (www.watermansfarmmarket.com) has a u-pick operation at two locations on the south and east sides of Indianapolis.

Institutions
Schools, universities, hospitals, culinary training programs, churches and food banks/pantries are also becoming increasingly interested in purchasing from local farmers utilizing sustainable practices, thus institutional distribution is worth considering for new farmers. One barrier to such an arrangement is that the volume of product that many institutions require may be beyond the scope of what an urban farm can provide. As an alternative, an urban farm could focus on one or two crops to grow for larger institutional distribution. There are some systematic barriers to work with institutions (particularly educational institutions and hospitals) whose food services are operated by corporate catering companies. Often these companies are not headquartered locally, so finding the appropriate person to approach can be difficult. If/when the contact is identified, he/she must be convinced that the price of the product is somewhat comparable to current pricing and convince the contact of the benefits of working with local farms and farmers. In the initial years of a farming operation, this is not likely the strategy to take, but in the midterm it may be worth considering

Big City Farms has distributed limited amounts of produce to food banks/pantries, or other agencies focused on providing free/inexpensive meals to those in need. Typically in this type of arrangement, the produce is purchased by a third-party non-profit or charity, to give the farmer a fair rate, and then given to the food bank/pantry. In an urban setting in particular, food access is a major topic of discussion and with more and more funding moving in this direction, distribution with this mission in mind could be a growing sector.

Mobile Market
There are various models of mobile markets that exist in Indianapolis and other urban centers, which involve taking product for sale directly to the homes/neighborhoods of customers. The set-up of such a system is only limited by the imagination of the grower and could take place by truck, car, bicycle, golf cart, or any vehicle of your choosing. Of course, there is additional labor and time in packing, transporting and keeping produce cool, but there is also the potential for increased sales by exposing a farm to new customers (think ice cream truck idea).

Final Thoughts on Distribution/Sales
Each farmer should decide on the distribution option(s) that work best for their farm. One way to reach this decision is to consider how much time each week the farmer can devote to harvesting. Some farms will focus on several days of smaller harvests and other farms will focus on one large harvest per week. In addition, farmers should establish a system that allows them to track their harvests and sales each week and throughout the growing season. This is of the utmost importance so the farmer can start to generate a year-to-year record of crops that sell particularly well/poorly and also have record of income generated by sale of their produce. At Big City Farms, we utilize Fresh Books, a fee-based on-line invoicing system (www.freshbooks.com), but a well-designed spreadsheet will serve the same function for free.

Developing a Farm Newsletter
In the potentially complex relationship between a farmer and his/her customer base, good communication is absolutely necessary. A common form of communication is a farm newsletter. The goal of a newsletter is to establish regular updates to your audience. In addition to reporting on current farming conditions and progress, newsletter topics might include community events or other opportunities for local activism. The newsletter is an opportunity for readers to follow along in the development of your farm, reflecting significant activities in its operation such as planting and harvesting, and to inspire your audience to become, and remain, involved in the production of growing their food.
www.extension.missouri.edu/p/G419

14. Crop Extension

Crop extension is the term used to describe when a farmer employs different techniques to provide improved growing conditions for plants which might have been transplanted before the last frost in spring or to continue growing after the first frost in the fall. This longer season means continuing production and income for the farmer. These techniques can be on a small scale such placing containers over a plant for frost protection by creating a small green house. Larger-scale techniques include cold frames, varying weights of row covers, high tunnels and hoop houses, and green houses.

Cold Frames

Cold frames are boxes low to the ground with a transparent top. They allow light to come in, keeping in warmth, and protecting plants from harsh weather. This is a way to start your plants earlier in the season and can help plants survive later into the winter. There are many different plans you can use to make a cold frame, some of which you can make out of items found around your house. Instructables.com has a great list of different cold frame plans.

Row covers

Row covers are used to protect plants from sun, rain, cold, wind and pests. Row covers, or low tunnels, are made from curved pipes that arc over the bed about every four feet and are covered with a plastic or breathable fabric that is secured along the sides and end of the bed. There are several different thicknesses you can use and different variations, such as floating covers or frost blankets, and there are many different ways to construct the row cover to improve harvesting access and ventilation. Whatever style you choose to work with, the general idea is to protect the crop from wind and cold, with the hope that it will continue to produce longer into the season.

Breathable fabric row covers are increasingly used in fresh fruit and vegetable production. They come in different thicknesses to allow different degrees of sunlight and water to permeate while protecting plants from wind, cold and pests. If frost is a major concern, a thicker row covering might be best, but that also means less sunlight will get in. In this case, uncovering the row on a sunny day is necessary. With a lighter fabric, light penetration will be improved, but frost protection will not be as good. There is even shade cloth that is used, not for protection against the cold, but against the heat of mid summer. This is especially helpful for lettuces, small greens, and some herbs that prefer cooler temperatures. Plastic covering can be used as well and provides great protection against the elements, but does not allow airflow and rows should be uncovered regularly. These row covers are often supported by arched pipes or PVC and are anchored down with bags of sand, bricks or other heavy items. For more information on row covers, we suggest Eliot Coleman's book *Four-Season Harvest.* Chapters nine and ten are dedicated to covered gardens and high tunnels.

High Tunnels/Hoop Houses

High tunnels are like row covers, but on a larger scale. They are unheated plastic tunnels, the skeleton of which can be made of wood, PVC pipes or metal pipes. Because high tunnels are constructed of a simple frame with minimal infrastructure improvements, the overall cost is much less than a greenhouse, while providing much of the same protection.

There are variations on sizes and styles, but high tunnels are tall enough to walk and work in, allowing enough room for plants needing more space than a low row cover can provide. Just like the row covers, high tunnels are used for protection from the elements, and are built to enable ventilation when needed. Additional insulation from the cold can be provided by adding low row covers over the beds inside the high tunnels, giving a double layer protection.

The cost of building a high tunnel will vary depending on the size. A great place to start planning your high tunnel is at www.hightunnels.org. It can give you an idea on what you might need and how much it might cost along with instructions and links to sellers.

Greenhouse

A greenhouse is a glass- or plastic-covered building where plants can grow year-round and be protected from the elements. It is heated by the sun but can also have an additional heating system with ventilation to help with airflow and temperature regulation. Because of this controlled environment, greenhouses can be expensive, but they provide the most assured protection from elements. For more on building a greenhouse, the West Virginia University Extension Service has information about planning and building a greenhouse (www.wvu.edu/~agexten/hortcult/greenhou/building.htm). Also, Farm Tek (www.farmtek.com) has useful information when planning and pricing greenhouses.

Overwintering

Overwintering occurs when a crop is planted early enough in the fall for roots to be established. When the cold months come along the plant growth slows, yet the crop is not completely killed by the colder temperatures. This can result in an earlier and sometimes healthier harvest. Some plants to consider overwintering include garlic, onions, parsnips, carrots, cabbage, cauliflower, and broccoli. Keep in mind that over wintering does not mean you can sow the seeds and leave them be. The plants need protection by applying any of the covers described above and/or mulching. An excellent book concerned with a popular, overwintered crop is Ron L. Engeland's book *Growing Great Garlic*.

15. Putting the Farm to Bed

When the summer markets are over, the growing has slowed, and the big harvest has come and gone, what remains is preparing the farm for winter. The chores on the farm at this stage of the season are meant to protect the soil life over the next few months (when temperatures will fluctuate from freezing to thawing), and to ease the workload of preparing the farm next spring. Before the ground freezes, the last of the remaining crops needs to be harvested, stored or composted, and all of the beds should be cleared and planted in a cover crop. Ideally, the beds receive a top dressing of fresh compost before being seeded with cover crop.

Four weeks before the first frost is about the time to seed a winter cover crop. Be aware that legumes are slower to germinate so you might get them into the ground before mid-September. Options for a beneficial winter cover crop are many, including oats, peas, rye, clover and hairy vetch. A cover crop of rye can be planted as late as the first frost. These crops hold the soil throughout the winter, decreasing erosion and the loss of topsoil that can happen with heavy wind and precipitation. They also contribute organic material when their roots and greens are incorporated back into the soil in the spring. Some of the roots of these crops will pull nitrogen up from deep within the ground, making it more available for the next spring and summer crops. When winter comes unexpectedly, or the chores of putting the farm to bed are too many, reprioritizing may be necessary. If clearing the beds of crop debris and adding it to the compost pile is not possible, chop what remains planted at ground level, leaving the roots, and shredding the debris, leaving it in the bed as mulch. Although this is not ideal, it is better than leaving the bed unplanted and exposed. Be as selective with this method as possible.

Vegetables in the brassica family (cabbage, kale, broccoli, Brussels sprouts and cauliflower) left in the ground may help attract then kill off insect nuisances like wireworms next spring by releasing cyanide compounds into the soil as it warms. Remove as much tomato and potato plant and debris from the beds as possible. Blight will feed on the living tissue of these plants and can survive the winter. Many growers will not even compost this debris for this very reason. Compost piles will still need turning throughout the winter.

This is the time to get an updated soil test so that you can use the results to guide next year's vegetable crop rotation and cover crop/companion planting plan. Then you can order the seeds that you need. Additional activities might include:

- Shovels, trimmers, hoes and all the various hand tools will need cleaning and sharpening before spring and any wooden handle could use oil rubbed into it.
- Harvest containers will need to be cleaned and sanitized.
- Row covers need to be stored. It would behoove the grower to label them individually, including length and width, to be used on the appropriate beds in subsequent seasons.
- Any machinery, farm vehicle, tractor, tiller or mower will need an oil change and other repairs.

- Do not forget to tune your bicycle; we at Big City Farms have found this to be a very reliable farm tool!
- Hoses and irrigation can be drained, rolled, labeled and stored. If drip tape is your method of irrigation and you plan to reuse it, it is a good idea to wash, or at least wipe down, the lines to remove any mineral build up at the emitters. Try not to tear or crease the line as you roll them up. Any exposed spigots or water lines need to be insulated so as to not freeze.

Do not neglect your client base, volunteers or various supports in your community over winter. Consider keeping an ongoing newsletter or blog to keep these supporters informed. Many people may have missed the window to be involved last season and only need a reminder of the upcoming opportunities to participate during the next season.
www.publicradiokitchen.wbur.org/2011/11/04/goodnight-field-putting-a-farm-to-bed

16. Time Management

Labor
There is a tremendous amount of physical, logistical, and emotional work required to operate a successful farm. The days are long and tasks often need to be completed, irrespective of the weather. In addition, it takes time, patience, and a certain degree of foresight to create a workable planting and harvest calendar for the upcoming growing season. On top of that, there still remains a fair amount of work, post-harvest, in regards to marketing and distributing the product that you have so carefully tended.

Many people who enter farming are particularly good at one of these areas (labor, planning, or marketing) and plan on increasing their proficiency in the other two areas while the growing season is in process. This seems to be the way that many new farmers start out – diving into the project with love, excitement, and the desire to reorient their lives entirely towards farming. This is wonderful to witness and heartwarming to support, but it is also a quick and easy road to burnout. As much as we want our crops to grow on enthusiasm and desire, pursuing farming as a full-time job requires planning and a thorough consideration of one's capacity and level of commitment.

Time Off
Growing quality produce can feel like a 24-hour, seven day a week job. Plants do not stop growing (or wilting, for that matter) just because the workday is over, and it is difficult to stifle the desire to check on new plantings or weed a particular plot one more time. However, plan on factoring in at least one day off during the week to not worry about farming. The physical and mental respite that such a break (even a short one) affords will go a long way towards ensuring that you are willing and able to maintain that initial level of excitement you might have felt when you first thought about starting your own farm.

Planning
When starting out, it is critical to ask yourself how much time you are willing to devote to the entire process of running a farm, how much money you think is fair to expect in return for your labor, and how the farm's general operations can be best formulated to meet your goals and needs. It is easy to let the excitement of growing good food for an appreciative public overshadow the toll that long hours and minimal income can take on you.

With that in mind, take the not-insignificant time needed to create a detailed, long-term business plan. It is not enough to simply dive in, thinking that you will grow vegetables and people will buy them. What is your market? What kind of vegetables does that market demand? Which of those vegetables can you grow successfully? What is your back-up plan if the growing season is less-than-stellar? These and many other questions need to be thoroughly considered before any soil is turned or seeds are planted. Spending this time on the front-end will save you significant energy and worry down the line.

The U.S. Environmental Protection Agency has created an excellent business-planning guide for new, urban farmers.
www.epa.gov/brownfields/urbanag/pdf/urban_farm_business_plan.pdf

Conclusion and Acknowledgements

It is our sincere hope that this manual has been, and will remain, a useful guide for current and future urban farmers and gardeners. There are many problems with our current food system and one way we can start to turn the system in a more sustainable, and pleasurable, direction is for individuals and groups to take a primary role in growing some of their own food. This could be in a yard, in a community garden or on an urban farm. As mentioned in the manual, possibilities in urban growing are often only limited by the imaginations of the future farmer or grower. We hope many people will take seriously the many possibilities that exist in and around Indianapolis.

This manual was researched and written throughout the 2012 growing season and though it captures a "moment in time" we hope the general lessons and information throughout the manual remain applicable for many years. We urge all future urban growers to continue to research as much as they can on growing healthy soil and interacting with as many other growers as possible in order to share information and lessons learned.

This manual was made possible by the United States Department of Agriculture Specialty Crop Block Grant Program and we thank Amy Etizinger-Ott from the Indiana State Department of Agriculture for her help with this grant. We owe a sincere thanks to other urban farms in Indianapolis that provided support and advice on this project including South Circle Farm, the Butler University Farm and Growing Places Indy. We also owe a debt of gratitude to urban farms throughout the country that allowed us to visit their operations giving us an invaluable opportunity for comparison while writing this manual. These include the University of British Columbia Campus Farm (Vancouver), Added Value Farm, Eagle Creek Rooftop Farm, East New York Farms!, BK Farmyards, Queens County Museum Farm (New York), The Food Project (Boston), Urban Growth (Cleveland), City Farm (Chicago), Alemany Farm (San Francisco), Hayes Valley Farm (San Francisco), the Intervale Center (Burlington, Vermont), Wealth Underground, 47th Avenue Farm, Zenger Farm, Slow Hand Farm, and the Beginning Urban Farmer Apprenticeship program of Multnomah County (Portland, OR).

Last but not least, we thank our CSA members and restaurant customers who worked with us patiently throughout the 2012 as we expanded the scope of Big City Farms to include an apprenticeship program and the writing of this manual. We hope your trust and investment in us will continue to result in beautiful, fresh vegetables for years to come.

Appendix A – List of Farms and Gardens in Indianapolis as of November 2011
Compiled by April Hammerand (Food Coalition of Central Indiana)

Community Gardens	Garden Address
Service Center Neighborhood Garden	3919 Lafayette Rd. Indianapolis IN 46254
We Care Community Garden	2529 West Jackson St. Indianapolis, IN 46222
Hawthorne Community Garden at the Hawthorne Community Center	2440 West Ohio Street, Indianapolis, IN 46222
Haughville Community Garden	922 N Sheffield Ave. Indianapolis, IN 46222
Stringtown Community Garden	1710 W New York St. Indianapolis, IN 46222
Riviera Community Garden at The Riviera Club	5640 North Illinois Street, Indianapolis, IN 46208
Cottage Home Neighborhood Community Garden	714 N Highland Ave. Indianapolis, IN 46202
Broadway Community Garden	3415 Broadway St. Indianapolis, IN 46205
Shared Farming Plots at the Butler Campus Farm	4600 Sunset Blvd. Indianapolis 46208
DIGS IUPUI garden at the Center for Young Children	321 Limestone St. Indianapolis, IN 46202
Shared Garden Space at DIGS (Developing IUPUI Gardens Sustainably)	402 Blackford St., Indianapolis, IN
Arsenal Avenue EcoCenter	110 N Arsenal Ave. Indianapolis, IN 46201
Community Garden on Temple	19 N Temple Ave. Indianapolis, IN 46201
Community Garden on Park	2900 N Park Ave. Indianapolis, IN 46205
Shared Garden Space at the Felege Hiywot Center	1648 Sheldon Street, Indianapolis, IN 46218
Chow Chow Community Garden	3339 N Capitol Ave. Indianapolis, IN 46208
Christian Park Community Garden of Christian Park Active Community, Inc.	4900 Farrington Ave. Indianapolis, IN 46201
New Hope Community Garden at __Zacchaeus' Tree Congregation	7019 S. Arlington Ave. Indianapolis, IN 46237
Living Well Community Garden	2415 N Rural St. Indianapolis, IN 46218
Children's Urban Garden at Garfield Park Conservatory	2505 Conservatory Drive, Indianapolis, IN 46203
Mayor's Garden Plots at Tibbs Ave. (Salvation Army Harbor Light Center)	2400 N Tibbs Ave. Indianapolis, IN 46222
Eagle Creek Park Gardens (John Geisse Soccer Complex)	5425 Reed Rd. Indianapolis, IN 46254
Seeds of Hope Community Garden	2870 N Olney St. Indianapolis, IN 46218
Fall Creek Gardens (north of Unleavened Bread Cafe)	3001 Central Avenue, Indianapolis, IN
Urban Mountain Farm Gardens with KI EcoCenter	955 W 36th St. Indianapolis, IN 46208
South Circle Farm at the Concord CDC - Community Garden Plots	2048 S. Meridian St. Indianapolis, IN 46225
Burkhart Community Garden in Rocky Ripple Neighborhood	840 W 53rd St. Indianapolis, IN 46208
The Project School Community Garden	1145 E. 22nd St. Indianapolis, Indiana 46202
Paramount School of Excellence Community Garden	3020 Nowland Ave. Indianapolis, IN 46201
Englewood Community Garden	57 N Rural St. Indianapolis, IN 46201
Emmerich Manual High School Gardens with Global Peace Initiatives	2405 Madison Avenue, Indianapolis, IN
Calvary Lutheran Community Garden	6200 Orinoco Ave. Indianapolis, IN 46227
Pot O'Gold Community Garden at Washington Park North Cemetery	2702 Kessler Boulevard West Dr., Indianapolis, IN
Green Broad Ripple	61st Street between Winthrop and Guilford,
Green Acres Urban Farm	1702 S Delaware St, Salsa garden
	1315 S Charles, Strawberry and pumpkin
Green Acres Urban Farm	1355 S Meridian general vegetable garden
Sprout Urban Farm	1156 Fletcher Avenue
Northsquare Community Garden	1033 Hosbrook
IPS #114	Raymond & Sloan
Shepard Community Garden	4107 e. Washington
Community Peace Garden	1129 S. Tremont
Friends and FACT Community Garden	Fletcher & I65
St. Peter Community Garden	1443 St. Peter
Fletcher Place Community Garden	Fletcher & College
Bradley Crime Watch Garden	29 S. Bradley
IPS #31 Pumpkin Patch	Lincoln and Alabama
Sumner's Garden	649 Holly Ave
Horse Shoe Harvest	206 N. Keystone Ave
IPS 27 Garden	545 E. 19th St.
Peaceful Grounds Cafe and Farm Market	167 Van Dyke Street; Southport, Indiana 46227
R-Bistro-- Slow Food Restaurant Garden	888 Massachusetts Ave. Indianapolis, IN 46202
Goose the Market --Slow Food Restaurant Garden	2503 North Delaware St. Indianapolis, IN 46205
Earth House Community Garden	237 North East Street, Indianapolis, IN 46202
Miracle Place - Pocket Park	940 West Temple (10th & Rural)

Jefferson Street Community Garden	937 Jefferson Ave. Indianapolis, IN 46201
Community Heights Garden at IPS School 88	5801 E. 16th Street Indianapolis
Pan Am Plaza	201 S. Capital
IPS 572 Garden	1202 E. Troy Ave
IPS 49 Garden	1720 W. Wilkins
IPS 42 Garden	1002 W. 25th St.
IPS 84	
IPS 69 with Felege Hiywot	
IPS 56 with Felege Hiywot	
Urban Garden Program	1950 Tallman, 1954 Tallman
Urban Garden Program	829 W. Roache Street
Urban Garden Program	1030 W. Roache St
Urban Garden Program	3438 E. 25th St
Urban Garden Program	2131 N. Linwood Dr., 2129 N. Linwood Dr.
Urban Garden Program	1552 N. Rural
Farms, Gardens, CSA, and Farm Stands	
Growing Places Indy (White River State Park)	801 West Washington Street Indianapolis, IN
Felege Hiywot Center	
Basic Roots Community Foods	341 N Hamilton Ave. Indianapolis, Indiana 46201
Big City Farms	907 East Michigan Street (Midland Antiques)
Brendle Honey Farm	
Waterman's Farm Market	
Fermenti Artisan Farm	2419 N. Ritter Avenue, Indianapolis, IN 46218

Appendix B – Big City Farms Soil Test from the UMASS-Amherst

SOIL ANALYSIS REPORT FOR HOME GARDENS 09/09/10

SOIL AND PLANT TISSUE TESTING LAB
WEST EXPERIMENT STATION
UNIVERSITY OF MASSACHUSETTS
AMHERST, MA 01003

LAB NUMBER: S100903-102
BAG NUMBER: 95372

SOIL WEIGHT: 5.71 g/5cc
CROP: VEG

[redacted]
COMMENTS: [redacted]

SAMPLE ID: MIDLAND SAMPLE #1

RECOMMENDATIONS FOR HOME GARDENS:

SOIL PH ADJUSTMENT:
Your soil pH is slightly higher than desired for most vegetables. Cole crops may prefer the current pH since they are more resistant clubroot infection under slightly alkaline conditions. Take care, however, not to incorporate any amendment that would further raise soil pH.

FERTILIZER:
** Your soil contains sufficient levels of potassium. You may apply the standard recommendations below, or you may provide sufficient nitrogen and phosphorus by using alternate sources to provide about 1/4 lb nitrogen and about 1/4 lb phosphorus per 100 sq ft.

** VEGETABLES: Apply 3-4 lbs 5-10-5 per 100 sq ft in early spring.

** ANNUAL FLOWERS: Apply 1.5 lbs 5-10-5 per 100 sq ft in early spring. Alternatively you may use one-half the ORGANIC recommendation given above.

** ROSE BUSHES: Apply 4 tablespoons of 5-10-5 per bush in early June and early August. None after August 15.

Avoid overfertilizing which can cause plant toxicity and can contribute to insect and disease problems.

MICRONUTRIENT		PPM	SOIL RANGE	MICRONUTRIENT		PPM	SOIL RANGE
Boron	(B)	0.9	0.1-2.0	Copper	(Cu)	0.1	0.3-8.0
Manganese	(Mn)	30.7	3 - 20	Iron	(Fe)	2.1	1.0- 40
Zinc	(Zn)	11.6	0.1- 70	Sulfur	(S)	187	1.0- 40

SOIL pH 7.4 NITROGEN: NO3-N = 13 ppm
BUFFER pH 7.4 ORGANIC MATTER: 9.3 % (Desirable range 4-10%)

NUTRIENT LEVELS:		PPM	Low Medium High Very High
Phosphorus	(P)	9	XXXXXXXXXXXXX
Potassium	(K)	323	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
Calcium	(Ca)	12786	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
Magnesium	(Mg)	297	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

CATION EXCH CAP	PERCENT BASE SATURATION	MICRONUTRIENT LEVELS
58.9 Meq/100g	K= 1.3 Mg= 3.7 Ca=95.2	ALL NORMAL

EXTRACTABLE ALUMINUM: 2 ppm (Soil range: 10-250 ppm)

The lead level in this soil is low.

VISIT www.umass.edu/soiltest FOR FURTHER INFORMATION ON SOIL TESTING AT UMASS.

Appendix C – Soil Sampling Instructions

Department of Horticulture

Purdue University Cooperative Extension Service • West Lafayette, IN

Collecting Soil Samples for Testing

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Testing garden soil for nutrient status is an easy and relatively inexpensive planning tool. Yet, it is an all-too-common practice for gardeners to apply fertilizer, lime, sulfur or other materials to their soils without knowing its current status. And sometimes this may do more harm than good. The old adage "if one pound is good, two is better and three is best" does not hold for things like applications of fertilizers, lime, or sulfur or even for organic matter, manures, and the like. A soil test will reveal the current nutrient status and whether additional nutrients should be added as fertilizer.

Soil pH (a measure of acidity or alkalinity) affects the availability of most nutrients for uptake by plants. Nutrients are most readily available to plants at a pH of 6.5. Most garden plants will grow satisfactorily within a wide range of soil pH. However, most horticultural plants grow best at a soil pH of 6.0 – 6.8 (slightly acid). To make soil more alkaline, lime is added, while to make it more acid, sulphur is used. Some gardening books will advise a general application of lime to garden plants. Yet most Indiana gardens have a soil pH that is already near neutral, if not slightly alkaline. So applying lime will not help and may hurt nutrient availability in these soils. Accurate lime or sulfur applications can only be made on the basis of this soil analysis.

Generally, a soil test will measure phosphorous, potassium, soil pH and organic matter. A nitrogen test is not usually done because nitrogen is not retained by soil and must be replenished every year. Tests for other nutrients may be available at additional cost. To get an accurate soil test, soil samples need to be carefully collected and prepared.

Timing

A soil test once every three to five years is usually adequate. However, if fertility and soil pH levels for specific plants are important to your plans, test more often.

Take the soil sample well before planting, so there is time to treat the soil. Soil samples can be taken any time the soil is suitable for spading or rototilling, but late summer or early fall gives enough lead time to plan ahead. However, if a situation develops that suggests soil fertility may be the problem, collect samples immediately. Taking soil samples from the "normal" and "abnormal" plant growth areas is helpful for comparison.

Tools

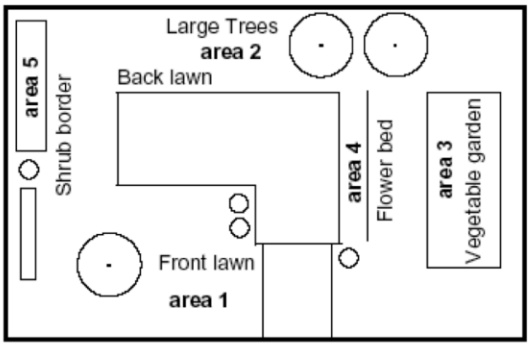
A soil probe or auger is ideal for taking soil samples, but a sharp spade, long knife or trowel can be used if you remove the same amount of soil from each sampling area. Place the soil in a clean pail or box until ready for packaging to send to the lab.

Sampling Techniques

Draw a diagram of your property where samples are to be taken. Sample dissimilar parts of the yard separately. Plot the areas to be sampled, then keep the diagram for future reference (see illustration).

Since only a small portion of the soil is used for testing, it is very important that the sample be representative of an area. Usually, it is better to prepare a single soil sample from several cores or slices rather than to have several tests made within

an area. So after you have divided the property into sample areas (front yard, shrub bed, garden, etc.), take several samples from each area. Mix these together by area to get your representative sample or "average" for each area. For large areas, 10-15 cores are needed, but for narrow shrub or flower borders, 4-6 cores will do the job. Be sure to take all samples from an area and place them together in a clean pail or box. Also, be sure to keep an accurate record of the sampled areas, and include this information in the soil report (called a field record) so you will be able to interpret the results.



Procedure

• Remove surface debris, such as plant residues, mulch or turf thatch, from the soil before inserting the soil probe, spade, or trowel.

• Sample gardens and shrub and flower beds to a depth of 6-8 inches.

• Sample turf areas to a 3-inch depth.

• Sample tree root zones to 8-12 inches or deeper.

• Sample row crops (in gardens) between the rows to avoid fertilizer bands.

• Sample light, dark-colored, limed and unlimed areas separately.

• Sample front and back yard separately if they have been managed differently or contain different types of fill soil.

• Dry samples at room temperature. (Do not use artificial heat.)

• Break up any lumps and remove all stones, debris, etc.

• When dry, mix well and crush so all the soil is the size of wheat grains or smaller, but do not pulverize.

• Remove 1 pint per composite sample and place in a clean, labeled container.

Testing

Many private laboratories in and around Indiana offer a wide range of soil testing services. To get price and other information, contact the laboratory of your choice before submitting your samples. The Purdue University Agronomy Department maintains a list of certified soil testing laboratories on their web site at:
http://www.agry.purdue.edu/ext/Soil_Labs.html.

You can also check with your local county office of the Purdue University Cooperative Extension Service to see if more local services are available.

Appendix D – Big City Farms Planting Calendar

	Indoor Seeding	**Direct Seed**	**Transplant**
January 31, 2011	**Leeks (1/2)**		
	Onions (1/1)		
	Scallions (1/3)		
February 1, 2011			
February 2, 2011			
February 3, 2011			
February 4, 2011			
February 5, 2011			
February 6, 2011			
February 7, 2011	**Leeks (2/2)**		
	Scallions (2/3)		
February 8, 2011			
February 9, 2011			
February 10, 2011			
February 11, 2011			
February 12, 2011			
February 13, 2011			
February 14, 2011	**Broccoli (1/1)**		
	Cabbage (1/1)		
	Celeriac (1/1)		
	Beets (1/3)		
	Swiss Chard (1/1)		
	Collards (1/1)		
	Kale (1/1)		
	Kohlrabi (1/3)		
	Lettuce (1/2)		
	Parsley (1/1)		
	Sage (1/1)		
	Scallions (3/3)		
February 15, 2011			
February 16, 2011			
February 17, 2011			
February 18, 2011			
February 19, 2011			
February 20, 2011			
February 21, 2011	**Beets (2/3)**		
	Celery (1/1)		
	Cilantro (1/3)		
	Lettuce (2/2)		
February 22, 2011			
February 23, 2011			
February 24, 2011			
February 25, 2011			
February 26, 2011			

February 27, 2011			
February 28, 2011	**Basil (1/2)**		
	Beets (3/3)		
	Cilantro (2/3)		
	Eggplant (1/1)		
	Fennel (1/3)		
	Husk Cherry (1/1)		
	Kohlrabi (2/3)		
	Pepper (1/1)		
	Tomato (1/1)		
	Tomatillo (1/1)		
March 1, 2011			
March 2, 2011		**Arugula (1/5)**	
		Radish (1/6)	
		Spinach (1/5)	
March 3, 2011			
March 4, 2011			
March 5, 2011			
March 6, 2011			
March 7, 2011	**Fennel (2/3)**		
March 8, 2011			**Lettuce (1/2)**
March 9, 2011			
March 10, 2011			
March 11, 2011			
March 12, 2011			**Lettuce (2/2)**
March 13, 2011			
March 14, 2011	**Basil (2/2)**		**Beets (1/3)**
	Cilantro (3/3)		
	Fennel (3/3)		
	Kohlrabi (3/3)		
March 15, 2011			
March 16, 2011		**Arugula (2/5)**	**Cabbage (1/1)**
		Radish (2/7)	**Swiss Chard (1/1)**
		Spinach (2/5)	**Collards (1/1)**
		Mustard (1/2)	**Kale (1/1)**
		Turnip (1/2)	**Kohlrabi (1/3)**
March 17, 2011			
March 18, 2011			
March 19, 2011			
March 20, 2011			
March 21, 2011	**Pac Choi (1/2)**		**Beets (2/3)**
	Lettuce (1/2)		**Cilantro (1/3)**
			Leeks (1/2)
			Parsley (1/1)
			Sage (1/1)
			Scallions (1/3)
March 22, 2011			

March 23, 2011			**Leeks (2/2)**
			Onions (1/1)
			Scallions (2/3)
March 24, 2011			
March 25, 2011			
March 26, 2011			
March 27, 2011			
March 28, 2011		**Arugula (3/5)**	**Broccoli (1/1)**
		Carrots (1/4)	**Cabbage (1/1)**
		Radish (3/6)	
		Spinach (3/5)	
March 29, 2011			
March 30, 2011			
March 31, 2011			
April 1, 2011			
April 2, 2011			
April 3, 2011			
April 4, 2011	**Cucumber (1/4)**		
	Lettuce (2/2)		
	Pac Choi (2/2)		
	Squash (1/4)		
April 5, 2011			
April 6, 2011		**Turnips (1/2)**	**Fennel (2/3)**
			Kohlrabi (2/3)
			Pac Choi (1/2)
			Beets (3/3)
			Lettuce (2/2)
April 7, 2011		**Arugula (4/5)**	
		Mustard (2/2)	
		Radish (4/6)	
		Spinach (4/5)	
April 8, 2011			
April 9, 2011			
April 10, 2011			
April 11, 2011			
April 12, 2011			
April 13, 2011		**Potatoes (1/1)**	**Beets (3/3)**
			Lettuce (1/2)
April 14, 2011			
April 15, 2011			
April 16, 2011			
April 17, 2011			
April 18, 2011	**Cucumber (2/4)**	**Arugula (5/5)**	
	Squash (2/4)	**Radish (5/6)**	
		Spinach (5/5)	
April 19, 2011			
April 20, 2011			

April 21, 2011			**Celery (1/1)**
			Celeriac (1/1)
			Pac Choi (2/2)
April 22, 2011			
April 23, 2011			
April 24, 2011			
April 25, 2011		**Carrots (2/4)**	**Basil (1/2)**
		Turnip (2/2)	**Husk Cherry (1/1)**
			Tomato (1/1)
			Tomatillo (1/1)
April 26, 2011			
April 27, 2011			**Eggplant (1/1)**
			Pepper (1/1)
April 28, 2011			
April 29, 2011			
April 30, 2011			
May 1, 2011			
May 2, 2011	**Cucumber (3/4)**		**Cilantro (3/3)**
	Squash (3/4)		**Lettuce (2/2)**
May 3, 2011			
May 4, 2011		**Beans (1/4)**	
		Carrots (3/4)	
May 5, 2011			
			Cucumber (1/4)
			Squash (1/4)
May 6, 2011			
May 7, 2011			
May 8, 2011			
May 9, 2011			
May 10, 2011			
May 11, 2011			
May 12, 2011		**Carrots (4/4)**	**Cucumber (2/4)**
			Squash (2/4)
May 13, 2011			
May 14, 2011			
May 15, 2011			
May 16, 2011	**Cucumber (4/4)**		
	Squash (4/4)		
May 17, 2011			
May 18, 2011			
May 19, 2011			
May 20, 2011			
May 21, 2011			
May 22, 2011			
May 23, 2011			
May 24, 2011			
May 25, 2011			

May 26, 2011			**Cucumber (3/4)**
			Squash (3/4)
May 27, 2011			
May 28, 2011			
May 29, 2011			
May 30, 2011			
May 31, 2011			
June 1, 2011			
June 2, 2011			
June 3, 2011			
June 4, 2011			
June 5, 2011			
June 6, 2011			
June 7, 2011			
June 8, 2011			
June 9, 2011			**Cucumber (4/4)**
			Squash (4/4)
FALL PLANTINGS			
July 25, 2011	**Broccoli (1/1)**		
	Cabbage (1/1)		
	Collards (1/1)		
	Beets (1/2)		
	Swiss Chard (1/1)		
	Fennel (1/2)		
	Kale (1/1)		
	Kohlrabi (1/2)		
	Leeks (1/2)		
	Pac Choi (1/2)		
	Parsley (1/1)		
	Scallions (1/2)		
July 26, 2011			
July 27, 2011			
July 28, 2011			
July 29, 2011			
July 30, 2011			
July 31, 2011			
August 1, 2011	**Beets (2/2)**		
	Leeks (2/2)		
	Scallions (2/2)		
August 2, 2011			
August 3, 2011			
August 4, 2011			
August 5, 2011			
August 6, 2011			
August 7, 2011			

August 8, 2011	**Lettuce (1/4)**		
	Fennel (2/2)		
	Kohlrabi (2/2)		
	Pac Choi (2/2)		
August 9, 2011			
August 10, 2011		**Carrots (1/2)**	
August 11, 2011			
August 12, 2011			
August 13, 2011			
August 14, 2011			
August 15, 2011	**Lettuce (2/4)**		
August 16, 2011			
August 17, 2011			
August 18, 2011			
August 19, 2011			
August 20, 2011			
August 21, 2011			
August 22, 2011	**Lettuce (3/4)**		
August 23, 2011			
August 24, 2011		**Carrots (2/2)**	
August 25, 2011			
August 26, 2011			
August 27, 2011			
August 28, 2011			
August 29, 2011	**Lettuce (3/4)**		
August 30, 2011			
August 31, 2011			
September 1, 2011			
September 2, 2011			
September 3, 2011			
September 4, 2011			
September 5, 2011			
September 6, 2011			
September 7, 2011		**Arugula (1/3)**	
		Mustard (1/3)	
		Radish (1/3)	
		Spinach (1/3)	
September 8, 2011			
September 9, 2011			
September 10, 2011			
September 11, 2011			
September 12, 2011			
September 13, 2011			
September 14, 2011		**Arugula (2/3)**	
		Mustard (2/3)	
		Radish (1/3)	
		Spinach (2/3)	

September 15, 2011			
September 16, 2011			
September 17, 2011			
September 18, 2011			
September 19, 2011			
September 20, 2011			
September 21, 2011		**Arugula (3/3)**	
		Mustard (3/3)	
		Radish (3/3)	
		Spinach (3/3)	

Appendix E – Vegetable Planting Guide

Vegetables	Space between rows1 (ft.)	Space between plants (in.)	Yield per 50 ft.	Amt. seed or no. plants per 50 ft.	Depth to plant (in.)	When to plant[2]	Days 'til first harvest
Beets	1	3	1 bushel	1 ounce	1/2-1	Apr 1-June 25	55-65
Broccoli (plants)	3	18	36 heads	36 plants	—	Apr 15-June 15	40-55
Cabbage (plants)	3	18	36 heads	36 plants	—	Apr 5-June 5	55
Carrots	1	2	1 bushel	1/2 ounce	1/2	Apr 10-June 20	70-75
Cauliflower (plants)	3	18	36 heads	36 plants	—	Apr 15-June 25	50-60
Cucumber	4	18	3/4 bushel	1 packet	1	May 15-July 1	55-70
Eggplant (plants)	2	24	60 fruit	24 plants	—	May 15-June 15	55-70
Irish potato (pieces)	3	10	1 bushel	60 pieces	4	Apr 20-June 1	90-130
Leaf lettuce	1	4	150 plants	2 packets	1/2	Mar 20-June 15[3]	40-50
Lima beans (bush)	2	6	1 bushel	1/2 pound	1-2	May 15-June 15	65-75
Onion (sets or plants)	1	2	1 bushel	1 pound sets	1-4	Apr 1-May 1	90-120 (dry) 60 (green)
Muskmelon	4	18	25 melons	1 packet	1	May 15-June 1	85-90
Peas	1	1	1 bushel	1/2 pound	2	Mar 20-May l	60-75
Peppers (plants)	2	18	2 bushels	36 plants	—	May 15-July 1	55-70
Radishes	1	1	500 roots	1/2 ounce	1/2	Mar 20-June 15[3]	25-30
Snap beans (bush)	2	2	1 bushel	1/2 pound	1-2	May 10-July 20	55 -60
Spinach	1	3	25 pounds	1 ounce	1-2	Mar 20-June 15[3]	40-45
Summer squash	4	48	100 squash	1 packet	1/2	May 15-June 15	50-60
Winter squash & pumpkins	6	72	25 -50 squash	1 packet	1	May 15-June 15	85-110
Sweet corn	3	12	50 ears	1 packet	1-2	May 10-July 10	65-85
Sweet potato (plants)	3	12	1 bushel	50 plants	—	May 20-June 10	130-140
Tomato (plants)	4	24	100 pounds	25 plants	—	May 15-June 20	40-70
Turnips	1	4	1 bushel	1 packet	1/2	Apr 1-June 15	60-90
Watermelons	6	48	15 melons	1 packet	1	May 15-May 25	75 -90

[1]In large gardens, distance should be adjusted for cultivating equipment.

[2]Early date is for Indianapolis. Plant 20 days earlier in extreme southwestern part and 10 days later for northeastern part of state. Late date is about the same for entire state.

[3]For a late crop, plant spinach and lettuce from Aug. 15 to Sept. 1; plant radishes from Aug. 15 to Sept. 15.

Purdue University Cooperative Extension Service
(www.hort.purdue.edu/ext/HO-32.pdf)

Appendix F – Big City Farms CSA Tracking Sheets

LARGE SHARE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	total	unit
Apples																		0.5	0.5	0.5			1.5	lb.
Arugula			0.5																		0.5	0.5	1.5	lb.
Asian Greens		0.5		0.5																			1	lb.
Basil						1	1			1	1	1	1	1	1	1	1	1				1	12	bu.
Bean									0.5		0.5				0.5			0.5					2	lb.
Beets			1	1	1	1	1	1	1	1	1				1			1	1	1	1	1	15	bu.
Bok Choy			1	1	1															1	1	1	6	bu.
Broccoli					1	1	1																3	head
Cabbage						1	1	1															3	head
Carrots									1	1	1	1					1						5	bu.
Celeriac																						4	4	head
Celery (cutting)								1	1						1	1			1				5	bu.
Celery (stalking)							1						1	1									3	bu.
Cilantro	1	1		1																			3	bu.
Cucumber																							0	lb.
Eggplant								1		2	3	4	3	3	4	4	4		2		2		32	fruit
Fennel						2	2	2	2														8	bulb
Garlic																			1	1	1	1	4	pint
Greens	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	1	1	1	27	bu.
Husk Cherry																							0	lb.
Kohlrabi			1		1	1		1															4	bu.
Leek					1	1				1	1	1	1	1									7	bu.
Lettuce (cut)			0.5																	0.5	0.5	0.5	2	lb.
Lettuce (head)	2	2		2	2	2																	10	head
Mint		1		1																			2	bu.
Mizuna		0.5																					0.5	lb.
Red Mustards	1		1																				2	lb.

Onion															**1**	**1**	**1**	**1**	**1**			**1**	**6**	**lb.**
Parsley			**1**		**1**				**1**											**1**	**1**		**5**	**bu.**
Peaches																**1**		**1**					**2**	**pint**
Pepper (hot)									**5**	**5**	**5**	**6**		**8**	**7**	**8**	**6**	**5**	**6**	**7**	**6**	**8**	**82**	**fruit**
Pepper (sweet)								**3**	**3**	**3**	**3**	**4**	**5**	**5**	**5**	**5**	**5**	**5**	**3**	**4**	**4**	**5**	**62**	**fruit**
Potato												**2**	**2**	**2**	**1**								**7**	**lb.**
Raab			**1**																				**1**	**bu.**
Ch Belle Radish	**1**	**1**	**1**	**1**																			**4**	**bu.**
Fr Br Radish	**1**	**1**	**1**	**1**																		**1**	**5**	**bu.**
Scallion	**1**	**1**	**1**	**1**			**1**	**1**	**1**														**7**	**bu.**
Spinach		**0.5**																					**0.5**	**lb.**
Squash (summer)								**1**						**1**									**2**	**fruit**
Squash (winter)																				**2**			**2**	**fruit**
Tomatillo										**1**	**1**	**1**			**1**								**4**	**pint**
Tomato (cherry)										**1**	**1**	**1**		**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**12**	**pint**
Tomato (slicing)											**1**	**2**	**2**	**2**	**1**		**1**	**1**	**2**	**1**	**1**	**1**	**15**	**lb.**
Turnip				**1**	**1**	**1**	**1**		**1**														**5**	**bu.**

SMALL SHARE	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**total**	**unit**
Apples																		**0.5**	**0.5**				**1**	**lb.**
Arugula																						**0.5**	**0.5**	**lb.**
Asian Greens		**0.5**																					**0.5**	**lb.**
Basil									**1**	**1**	**1**		**1**	**1**	**1**	**1**	**1**						**8**	**bu.**
Bean																							**0**	**lb.**
Beets (mixed)			**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**				**1**							**1**	**11**	**bu.**

Bok Choy			**1**	**1**	**1**														**1**	**1**	**1**	**6**	**bu.**
Broccoli																						**0**	**head**
Cabbage																						**0**	**head**
Carrots									**1**	**1**	**1**											**3**	**bu.**
Celeriac																						**0**	**head**
Celery (cutting)							**1**															**1**	**bu.**
Celery (stalking)								**1**	**1**													**2**	**bu.**
Cilantro																						**0**	**bu.**
Cucumber																						**0**	**lb.**
Eggplant										**2**	**3**	**3**	**3**	**3**	**4**	**3**						**21**	**fruit**
Fennel							**1**															**1**	**bulb**
Garlic																		**1**	**1**	**1**		**3**	**pint**
Greens	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**2**	**2**	**2**	**2**	**2**	**1**	**1**	**1**	**27**	**bu.**
Husk Cherry																						**0**	**lb.**
Kohlrabi							**1**															**1**	**bu.**
Leek						**1**				**1**	**1**	**1**	**1**	**1**	**1**							**7**	**bu.**
Lettuce (cut)			**0.5**																**0.5**	**0.5**	**0.5**	**2**	**lb.**
Lettuce (head)	**1**	**1**		**1**	**1**	**1**																**5**	**head**
Mint																						**0**	**bu.**
Mizuna	**0.5**																					**0.5**	**lb.**
Red Mustards		**1**																				**1**	**lb.**
Onion															**1**	**1**	**1**	**1**				**4**	**lb.**
Parsley						**1**		**1**														**2**	**bu.**
Pepper (hot)											**5**			**5**	**5**		**5**	**5**	**5**	**5**	**5**	**40**	**fruit**
Pepper (sweet)											**4**	**4**	**4**	**4**	**2**	**6**	**5**	**4**	**3**	**3**	**3**	**42**	**fruit**
Potato														**2**		**4**						**6**	**lb.**
Raab																						**0**	**bu.**
Ch Belle Radish				**1**																		**1**	**bu.**
Fr Br Radish	**1**	**1**	**1**																			**3**	**bu.**
Scallion	**1**	**1**	**1**	**1**			**1**	**1**	**1**													**7**	**bu.**
Spinach			**0.5**																			**0.5**	**lb.**

Squash (summer)																						**0**	**fruit**
Squash (winter)																			**2**			**2**	**fruit**
Tomatillo											**1**	**1**	**1**	**1**								**4**	**pint**
Tomato (cherry)															**1**							**1**	**pint**
Tomato (slicing)											**2**	**2**	**2**	**1**			**1**	**1**	**1**		**2**	**12**	**lb.**
Turnip					**1**	**1**		**1**	**1**							**1**						**5**	**bu.**