Year-Round Greenhouse Production at Sunrise Ranch

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**I. Abstract**

The idea of year-round production tapped into so many of my desires and ambitions. Seeing the great potential the farm greenhouse had, and the need for more farm to table options year-round, especially in the winter, I vowed to revitalize this greenhouse by using its existing permaculture elements as well as experimenting with new ones. There were four main phases: clean up and maintenance, soil building and bed preparation, crop production, and thermal regulation. At the time of this report, winter is nearing and therefore the last two phases should be observed and noted for correlations.

**II. Background & Description**

 As a student at the University of Vermont, I was privileged enough to take a course with Dr. John Todd, a pioneer in ecological design and inventor of the living machine. Through lectures and readings, I became fascinated with the power of plants and the interconnectedness of natural systems in an environment. Carrying this fascination with me, I sought to employ my own version of his inventions at Sunrise Ranch. After seeing the potential of the farm greenhouse, I wanted to install his idea of solar algae ponds with the intent that they would provide supplemental heating and growing surface for hydroponic lettuce. These two functions met two of the community’s needs: ‘farm to table’ dining year round and frequent consumption of salad greens. Fusing the community’s needs with my passions for sustainable food, I saw the farm greenhouse as a huge opportunity to experiment with and move toward year-round crop production that could supply the kitchen.

 The greenhouse has a “subterranean heating and cooling system”, which works by using a fan and vents to circulate hot air from underground to above soil and vice versa depending on the temperature inside the greenhouse. In fact, Sunrise Ranch resident, John Cruickshank, invented this system and the farm greenhouse is a living example of his work. While this method uses limited energy, I still wanted to test how much thermal mass the water barrels could hold and release. With either or both of these systems running, I believe a plethora of food crops could be grown throughout the colder months.

**III. Goals & Objectives**

 Since I had studied permaculture and sustainable food systems from a theoretical standpoint in the collegiate classroom, I wanted to put my ideas into action, with my own hands in the soil, and learning by doing. The primary motivation for having a greenhouse as a project platform was that I could learn how to grow things on my own. I needed to learn about the sowing calendar, water usage, plant lifecycle, soil needs, harvest strategies, the effect of temperature, and more. Ultimately, by the end of the project I aimed to have confidence to take a leadership role in growing food.

I also sought to earn a great personal achievement by transforming something rundown into something flourishing and valuable. Thus my project goal for Sunrise Ranch was to bring “The Farm” back to life by having year-round production capability. I would also like to see this greenhouse serve as an example of Permaculture practices that will put Sunrise Ranch on the map of innovation and progressive thinking in the field of sustainable living. In accordance with the community’s desire to practice sustainable living and organic farm to table dining, the greenhouse would increase self-sufficiency by supplying more local foods to the kitchen during the winter. An underlying goal of the renovated greenhouse, and ultimately a rejuvenated Farm area, is to create community cohesiveness around sustainable agriculture and food systems.

**IV. Project Strategy & Activities**

In order to regenerate the farm greenhouse many resources were required including labor, seed, irrigation, plastic, wood, barrels, tools, books, and mentors. I initially planned on having monthly meetings with my advisor and director of operations at Sunrise Ranch, Steve Short, but alas we had a mere two and a failed attempt at a third. My second meeting with Steve included the newly hired head chef, Joel Navejas, and focused on the Ten Year Agriculture Plan, the Farm to Table mission and whether or not this team was truly serious about becoming food sustainable year-round and having a dining menu to reflect that seasonality and locality.

My strategy for acquiring construction materials was to use whatever could find down at the farm. Whether or not I had a budget to work with, reusing material rather than buying new is more sustainable and in agreement with permaculture principles anyway. Unfortunately, there was not enough plastic to repair the tears on the east wall so a whole new roll of 6mil plastic film was ordered. Of course, this will be used on other projects in the future.

Throughout the Permaculture Program, I relied on a few Wednesdays to get help from all the interns in order to achieve some more daunting, large-scale tasks. Their help was invaluable and provided game-changing progress during seemingly stalemate times. Knowing that many hands make light work, I first called on the team for support in clearing out the junk that had accumulated in the greenhouse. By the end of the workday, the shelves and tables were clean and organized. The next major activity was sawing the plastic barrels to size in order to hold water and fit underneath the big table in the greenhouse. The idea behind the water barrels (solar ponds) is that during the day the sun heats up the water, which then releases that energy during the night. Ideally, with enough water mass, the temperature in the greenhouse will increase. According to the student greenhouse manager at CSU, barrels are only efficient if they do not take up growing space. While I originally planned on putting the barrels along the south side directly along the plastic where they would get the most sunlight, this area is where the third garden bed lies. My project partner at the time suggested we put the barrels under the big table where they weren’t taking up growing space but could still capture sufficient sunlight. Time and energy did not allow for hydroponic lettuce experimentation. As the weather started to approach freezing temperatures and the greenhouse still had torn, unsealed plastic film, I began to get anxious. Luckily, we had a community workday at the farm and with the help of a few community members we had the greenhouse sealed up in just a few hours! I was ecstatic. It was the last major project I wanted to complete before my departure.

As part of the plan to rebuild the soil I chose to plant two different cover crops for variety and comparison. I chose millet and buckwheat because for one we already had the seed, and secondly that they did very well in warm summer months. The function of the cover crops was to reduce and prevent bindweed, add organic material, and recycle nitrogen in the soil. Over the winter, I suggest turning in the fully matured cover crops into the soil to serve as green manure and sheet mulch.

On the west ends of the beds where both cover crops mysteriously did not germinate, I chose to plant the food crops. Using Eliot Coleman’s Winter Harvest Handbook, I chose to plant tatsoi, a hardy Asian green, and mâche, which grows no matter how cold. I also planted left over arugula and chard seeds from the garden, as they also thrive in cooler temperatures. It is important to plant what you love, and I happen to love arugula but never saw it in our salads. On September 21st, I brought my first harvest of arugula to the kitchen and saw it in a salad later that week—truly rewarding!

Because the true test of the greenhouse is its performance during the winter season, arrangements must be made on who will take over stewarding the crops. The most pressing situation is returning water to the greenhouse, and I suggest that the farm manager do so by perhaps running a hose from a residential water system. Next, I would like to see the grow tube and all beds completed and amended in time for early spring plantings. The growing season at Sunrise Ranch is now year-round! Therefore, a new garden strategy for scheduling labor and planning production is needed to account for that.

**V. Success & Challenges**

The greenhouse project had several phases, each with their successes and challenges. The first phase featured a complete makeover of the inside, which had been overrun with miscellaneous farm equipment. To do it by oneself would have been an enormous challenge, but with the help of the permaculture interns on a group workday, we succeeded wonderfully at a seemingly impossible mission. In fact all the days when I received help were successful, because as mentioned above, we completed big tasks that I would have struggled, if not failed, at doing myself. Although it may be too early to say whether or not the millet cover crop significantly amended the soil, it certainly succeeded at reducing bindweed. The installment of the soaker hose was a huge success as it turned an initial low germination rate to nearly 100%. The soaker hose left less room for human error because it was more consistent as long as I remembered to flip on the faucet. I could leave the water on unattended for several hours, rather than having to leave my daily schedule to walk the long dirt road down to the farm from the main community.

 Once I planted seeds, all the existing challenges were now magnified. The greenhouse was in my permaculture Zone 4 of 5, which means it was almost the untouched wilderness, and a place less easily accessed everyday. Although it was out of sight, now with seeds planted and needing water I could never let it get out of mind. Also, the time allotted to the project could no long wait for or be restricted to Friday afternoons, so I had to either put in off schedule hours or remember to put my normal garden schedule on pause to tend to my experiments down at the farm greenhouse.

 Before I even planted seeds, a big challenge was getting out of my planning phase where I perused chapters and chapters of a variety of sustainable agriculture books and articles. I enjoyed gathering as much information I could for inspiration on my own potential experiments. I realized that during the month of June I was overwhelmed with the idea of actually getting over the hump and starting the projects. Finally, with the help of group projects and my decision to stop procrastinating, I begin putting in truly transforming work to the greenhouse. I think that keeping up with advisor meetings would have helped me shift from the preparation phase to the implementation phase sooner as I would have had constructive feedback and motivation. Of course, having an advisor that is one of the busiest people at Sunrise Ranch makes it difficult to arrange meetings consistently. I know that Steve would have helped me establish a system for collecting quantifiable data, which was an initial objective that completely fell by the wayside.

 Another more immediate challenge is having the water shut off for the winter and not having an alternative irrigation method. Also, now that I am departing Sunrise Ranch, and have been absent on the weekends, arranging someone to take over the care of the plants has been merely a side-thought.

Overall, this project was a rollercoaster of activity, accomplishment, setbacks, and insight, and as a whole a great success.

**VI. Community Impact**

By renovating the greenhouse this year, I was able to bring some greens to the kitchen, but more importantly pave the way for year-round greenhouse production, which will be a vital element to the community’s self-sufficiency, farm to table menu, and culinary institute. I believe it also has potential to be a unique permaculture site for classes, educators, students, and visitors. By revoking the myth that you can only grow food from April-October, Sunrise Ranch will be a living example of sustainability in the 21st century and the importance of this type of food system.

The big jobs of cleaning out junk, sawing barrels, and repairing plastic brought the community together. Most notably, the greenhouse was an arena for helping hands during the Community Work Party at the Farm. Furthermore, those who helped were rewarded with hamburgers dressed with arugula from the greenhouse. Arugula within 50 yards of your dining table—could you get more local than that?

An underlying goal of the renovated greenhouse, and ultimately a rejuvenated Farm area, was to create community cohesiveness around sustainable agriculture and its opportunity and gifts it offers. I believe that my project will have lasting impact on the community, and I look forward to seeing where it evolves.

**VII. Personal Reflection**

The completion of this project brings enormous satisfaction. I came to Sunrise Ranch will the goal of becoming more “plant literate” and my work with this greenhouse project played a huge role in that. In fact, the notion of an Independent Study Project was an appealing factor in my decision to participate in this apprenticeship program, as it would give me the opportunity to grow and learn individually, and at the end of my time I would have a report to show for it. I knew coming into this project that I was an achiever, and someone who enjoyed transforming places, people, or things into something more sustainable. Bottom line was that I enjoy making a powerful difference.

Completing this project is even more satisfying given the response I heard from fellow interns who have attempted the same project but gave up. Perhaps this negativity fueled the fire even more, and gave me greater incentive to prove the patterns wrong and actually get the greenhouse back in production.

I learned about my creative cycle as it relates to long-term projects. I always start out very ambitious. With this project, I had big plans of aquaculture, biodomes, grow tubes, and more. I realized I needed to focus in on one thing and do it well. Even after a more focused plan of attack, I still did not get to some things that I would have liked. About the same time that I was spending less time at the Ranch, the greenhouse was calling for more attention. I failed to germinate a second batch of greens, which has been the biggest failure looking back on the process. It was incredibly frustrating to accept that I would not be growing another crop to experiment and potentially supply the kitchen with during the winter.

Overall, I am incredibly proud of my diligence and efforts to carry through with this project. I do not believe I have ever fully committed to a work project this long and I am celebrating the successes, as well as the failures, because I will learn from those and move on with confidence in the field of greenhouse growing and general gardening practices.

**VIII. Future Recommendations**

As far as the future of the greenhouse is concerned, I would like to see more of its year-round potential tapped into. In order for that to happen, some beds still need to be repaired and their soil replaced or amended. I believe that monitoring temperatures throughout the winter will be vital in establishing legitimate records and indicating what crops will survive in threshold temperatures. I would like to see tomatoes and other warm weather growing in this greenhouse and tested on their performance in the post-frost season. To tap until its fullest potential, vertical space should be utilized, whether it is with the grow tube system, trellises, or green walls, inside should be a flourishing microenvironment of plants. Lastly, I recommend that the greenhouse never become a place to store miscellaneous farm equipment and junk. There is plenty of storage space across the road, and anything that makes its way into the greenhouse should have a specific purpose to the practice of growing year-round.

Concerning the Independent Study Project, I think the format would benefit from “Project Group Days” where individuals could get help from their peers on certain aspects of their projects in place of Permaculture Wednesdays or Friday afternoons. This would allow for more progress to be made for permaculture as a whole at Sunrise Ranch. More frequent check-ins or monthly evaluations on the progress of an individuals project would also increase the quality and fulfill higher expectations. Advisors should be willing and able to participate in being a helpful resource for their intern, so expectations and agreements may need to be laid out ahead of time. Lastly, as I am writing this paper last minute, I would encourage setting a rough draft due date a couple weeks before the final paper is due in order to give the intern time for feedback and editing, which would consequently raise the overall quality of the final product.

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**X. Appendices**

**a.** Documentation and Timeline of Greenhouse Project Activities

**Mid-May:**

Mission Impossible: Operation Clean out Greenhouse! Received vital help from garden team to completely clean out the abandoned farm greenhouse. All materials not relating to the production of food crops was removed.

**Between May and June:** A lot of time researching permaculture techniques regarding winter food production, which provided lots of inspiration. Also gathered materials for these ideas including water barrels, grow tubes, and other possibly useful items for creative growing.

**Mid June:** Removed weeds, mostly bindweed, from the beds. Received vital help from Kev who provided motivation to get over the seemingly overwhelming task of removing bindweed.

**July 20th:** Planted buckwheat and millet seeds to begin soil regeneration. Also brought in some chicken manure and mixed it into one of the beds. Intention is to experiment with soil additive techniques.

**July 27th:** Started installing an irrigation system using soaker hose. At this point, only 5% germination of cover crop seed.

**August 1st:** farm team party! Sawed water barrels down to size. Prepared beds by removing wooden and metal shelving and poles, Removing more bindweed, and resowed cover crops (only reached 10% germination after first sowing). Made note that lack of water was likely reason for low germination and have been diligent since then to water everyday so seeds don’t dry out.

**August 3rd:** Feeling very happy and accomplished about the physical work done in the greenhouse, able to allow time for paperwork and planning i.e. begin output package, examine next project phase, do further research on season extension techniques.

**August 14th:** The colder morning reminded me that it’s time to start repairing the plastic on the east wall of the greenhouse. Germination from second sowing has reached only about 40%, and nearly no germination on west side of the beds. Did the seeds dry out too soon again? Is the heat or concentrated chicken mulch too much?

Things To Do:

Remove bindweed

Set up soaker hose

Plan out calendar

Order plastic tracking

Do more soil building research/bindweed management

Susannah suggested I plant arugula, chard, lettuce, and beets as soon as possible, but Steve has been too busy to meet with me to talk budget, visions, next steps etc.

**August 18th:** Met with Susannah to order seeds.

**August 21st:** Planted 4 rows of arugula and swiss chard in each bed on the western side where cover crops did not germinate. Will set up soaker hose irrigation ASAP.

**August 22nd:** Patrick helped me set up soaker hose. Adjustments need to be made to ensure more surface area is getting watered. Until seeds begin to germinate, I will have the system on for 1 hour in the morning and evening. On Friday the 24th I will collect pine needles to mulch over the soaker hose.

**August 28th:** Noticed some old buckwheat and millet seeds have decided to germinate—credit that from the extra moisture provided by soaker hose. Other seeds have arrived, will prepare last bed Friday the 31st (hoe bindweed and set up last soaker hose). Considering succession planting to determine ideal dates for growing the particular crops.

**September 21st:**Pipe change cancelled so I did my first arugula harvest! Brought 4.5 lbs to the kitchen.

**September 24th:** Planted a handful of mache and tatsoi in the bed with chicken mulch, as well as filled in space in arugula bed.

**October 3rd:** No germination in chicken manure bed (attribute to lack of water). Limited germination in arugula bed, which has a consistent water source.

**October 5th:** Reseeded chicken manure bed with the intention to use the soaker hose to avoid lack of water.

**October 10th:** Community work party down at the farm. With extra hands, more plastic, and plastic tape, we finally sealed up the greenhouse! Feels cozy in there—water barrels still need to be filled. Harvested some arugula for the picnic, but the leaves were too bitter and spicy from overgrowth and overheating.

**October 15th:** Still no germination of the hardy winter greens. Conclusion: chicken manure concentration too high/not a viable seed germination medium. Hoping that the handful of seeds that did germinate can provide a sufficient base for experimentation. Arugula looking happier that the weather has cooled. Need to do a second harvest of arugula and first harvest of chard ASAP. Unfortunately, the greenhouse has once again become a destination for junk and things without a known home. Frustrating to see, but I suppose it was bound to happen.

**October 22nd:** Harvested arugula and chard and brought total of 9 lbs to kitchen.

**October 23rd:** Began turning millet and buckwheat into soil to serve as green manure. Water has been turned off, not sure how to irrigate my crops!