Agricultural & Forestry Economics and Management (2023)
Clausius Scientific Press, Canada

DOI: 10.23977/agrfem.2023.060103
ISSN 2616-2202 Vol. 6 Num. 1

Evaluating the Economic and Environmental Cost for Onsite and Offsite Composting

Xiaoguo Geng

Wyoming Seminary School, 201 N Sprague ave, Kingston, United State
xiaoguogeng@gmail.com

Keywords: Composting, Onsite Composting, Offsite Composting, Bokashi Composting, Carbon Dioxide Emission

Abstract: With people getting increasingly familiar with climate change adaptation, composting has become a popular way for people to take action on protecting the earth. In the U.S., 30-40% of the food supply is wasted, and in restaurants, 74% of the waste is organic material. In 2018, the EPA estimated that 2.6 million tons of food (4.1% of food waste) was made into compost. However, there are two different kinds of composting: sending waste to a composting company (offsite composting) or composting at the place where waste creates (onsite composting). The author conducted a case study at a high school in Pennsylvania, USA, and designed a Bokashi composting experiment and an evaluation model to compare the economic cost and carbon dioxide (CO_2) emission for onsite and offsite composting. The study finds that the cost of 1 kg of food waste for onsite composting is $0.29 and that for offsite composting is $0.22 (a 24% reduction). However, in this case, the onsite composting causes 0.014 kg of carbon dioxide equivalent (CO_2e) per kg of food waste, while the mission of offsite composting is 0.035 kg of CO_2e. It means that switching from offsite to onsite composing would result in a reduction of 21 kg of CO_2e for 1000 kg of food waste, which is the amount of waste produced by a high school campus with 400 people within just about five days to a week. It is worth knowing that 21 kg of CO_2e equals the amount of CO_2 a mature tree can capture in an entire year. Therefore, onsite composting costs are higher but have more environmental benefits than offsite composting.

1. Introduction

Early in the middle age of Europe, food waste became the source for managing the soil. However, as time went on, in the early 20th century, the soil was damaged a lot. The growing population and urbanization lead to the higher food requirement; thus, the government started to use synthetic fertilizer to improve the production. They also encourage and appeal farmers to use synthetic fertilizer which absolutely harms the soil a lot. Until recently, more and more people started to study Organic agriculture and gardening, the agriculture study about soil health got popular. Barack Obama installed composting bins in White House [1], Eliot Epstein wrote a book called “The Science of Composting,” and scientists around the world published tons of articles about composting [2]. Also, solid waste, sewage sludge, biosolids and landfill costs got more and more attention from people. Especially about

the landfills, it drives the increase of one of the greenhouse gasses, methane, which damages the atmosphere more than 20 times worse than carbon dioxide (CO_2) [3].

To solve this problem, composting is a good way to change those organic waste to things that can be used for gardening and agriculture products. Composting is one layer of soil and is also a biotic process which uses microorganisms to metabolize easily degraded organic matter into nutrient-rich humus [4]. By doing composting, it not only helps with improving the soil fertility but also helps repair soil that has been damaged by hydrocarbon, heavy metal, or chemical pollution, and even help filter pollutants from stormwater runoff.

Composting is one of the most important actions for Climate Change Adaptation. Different from trying to help earth back to states like a hundred years ago, the idea of Climate Change Adaptation points out that people should learn how to live under the changing climate. By doing this, the researcher reduces the vulnerability that humans can be affected by the climate and even get benefit from it. To cater to this idea, how to deal with trash people every day has become a controversial topic to discuss. In America, 30-40% of food supply gets wasted, and in the restaurant, 74% of the waste is organic material [5]. Due to the large amount of waste, people start to take action. In 2015, the president of America ordered Federal agencies to do their best to achieve "Zero-waste" by recycling and composting the non-hazardous waste. In 2018, EPA estimated that 2.6 million tons of food (4.1 percent of wasted food) got composted. Different regions in America started to vigorously deploy "Zero-waste" construction; for example, San Francisco, which is the most environmentally friendly city issued the "C40 Comprehensive Promotion of Zero Waste Declaration," and seated up high development goal of "Zero-waste city" and invited many cities around the world to jointly sign to promote "no-waste" construction [6].

Indeed, there are many ways of composting, and the way the researcher will talk about in this essay is Bokashi. This is a method based on the fertilization of food waste. The history of Bokashi can be traced back to ancient Korea and Japan. The first group of people buried their food waste and let microbes in fertile soil break down food waste to improve the production. For now, Bokashi connects food waste with specific microbes, and then solidifies or adds the resulting material to regular composting [4]. It is an anaerobic composting process, which does not cause many odors. However, besides the different methods for composting, there are also two ways for where to do the compost. Taking the waste to the composting company to process is called "offsite composting;" doing composting by people themselves in their home, at school or at their company where the waste primarily created is called "onsite composting." Onsite composting has been considered an alternative method for restaurants in San Francisco to dispose of their organic waste. According to the experiment on one large Emeryville restaurant, the onsite composting illustrated the most value both on ecosystem and economy [7].

Does onsite composting by people themselves benefit more or off-site composting is better for the environment? In this paper, the author developed an experiment and an evaluation model to compare the carbon emission for both the onsite and offsite composting, collected and analyzed experiment data, and discussed advantages and disadvantages for both ways. After getting the result from this research, facilities with large amounts of food waste such as school campuses and office buildings can refer to the experiment and evaluation methods to determine whether onsite or offsite composting fits better for a specific site. Besides, if a school would like to do onsite composting on campus, students can participate in the process of making the bin and observe during composting. It can not only engage students in community engagement and project-based learning, but also improve their awareness of protecting the environment.

2. Method

2.1. Preparation

First, the researcher collected the basic information about on and offsite composting for the school, so a brief comparing form including location, effort, duration, benefit and limitation for both sites was created. After that, a specific onsite composting system was designed and built, which, for this case, is a Bokashi composting system. Before conducting the experiments, the researcher also listed out the procedure of the experiments, all the materials needed, and calculation methods to estimate CO_2e and monetary costs of both onsite and offsite composting.

2.2. Onsite Composting Experiment

Table 1: Bokashi Composting Steps.

	Items needed	**Step 1**	**Step 2**	**Step 3**
Preparation	- Two 3–5-gallon buckets - One spigot and the one connecting tube - drill	Drill a few holes at the bottom on one bucket.	- Drill another hole on the side on the 2nd bucket. - Install spigot to the side of the 2nd bucket and make sure it is at the place where liquid can outflow.	- Put the 1st bucket with holes in the 2nd bucket and air tight as much as possible - Put a thin layer of tape inside the outer bucket to tight them to make it tighter if needed.
Composting	- Bokashi bran - Food waste (fruit from dining hall) - one plate	- Add one layer of bokashi at the bottom of the bucket. - Put food waste in, no more than two inches. - Add bokashi on the top of food waste.	- Add something heavy (like a plate) on top to provide an anaerobic environment (no air at the top. - Press down to make sure the bucket is air free.	- Close the lid, but stir the waste every day. - Observe the changes daily for a few days until bokashi tea is formulated.
Application of fertilizer	- Water - Jars - Gloves	- Drain bokashi tea from spigot. - Mix a teaspoon of bokashi tea in a gallon of water and use it to water (apply the bokashi tea within a day for best results).	- Let the waste in the bucket sit for two weeks until it become fertilizer. - Take out the fertilizer and apply to plants.	Three ways to use the fertilizer: 1. Bury it in fallow ground two weeks before plantation to avoid harms of its acidity. 2. Feed it to worm farm. 3. Add it to traditional compost piles as a booster.

The container use to do the composting should look similar to figure 1.

Figure 1: Bokashi Composting Container.

2.3. Assumptions

Since some of the data is difficult to accurately measure, there are some assumptions in this calculation. First, the researcher assumed that each composting bucket contains 8 kg of food waste. 1 gallon is equal to about 3 kg and considering that there will be Bokashi bran and some empty place at top, the 3-5-gallon should contain about 8 kg of food waste. What's more, the researcher assumed that the life cycle of the bucket is 100 times of use and so do the thrush can for offsite composting. This is because the thrush can used in the school dining hall needs to change in about three months, and that's nearly 100 times using. Also, the food waste per meal was assumed to be about 20 kg because the researcher measured her own food waste weight, about 150 g, and times it by the border number, which is about 130 people. Lastly, the researcher assumed that each 8 kg of food waste need to use 0.02 kg of bokashi bran. This is because the diameter of a 3-5-gallon bucket is about 20 cm, and the need of Bokashi bran is just a thin layer, 20g should be enough.

2.4. Offsite Composting

For the offsite composting, there is a composting company called DAMA Compost Facility at Dallas, PA 18612. School collects the food waste and sends it by truck to the composting company. Since the facility is near the researcher's school, the transportation emission is not extremely high. For the composting method, the company puts waste in a drum, silo, or concrete-lined trench and controls the environment with a waste management facility. It takes about three months for the facility to create dark soil products which contain high nutrient in it and sell them to farmers around.

2.5. Comparing On/Offsite composting

The onsite composting only takes two weeks to a month to complete and get the final product, but the offsite composting needs way more time to finish. Also, the product created by onsite can be used directly on school plantations, but if the researcher sends the waste to the facility, there is no feedback.

2.6. Limitations

Because of the difficulty of finding accurate data, this experiment has two limitations. First, the carbon emission of a composting company, Bokashi bran making and car for transportation are estimated numbers because they cannot be accurately calculated out. Second, the carbon emission from place of production to market is estimated because it's hard to directly trace back.

3. Findings and Analysis

This chapter presents the experiment results and compares the costs and carbon emission of the Bokashi and offsite composting. Further, it provides recommendations for school composting and discuss feasibility of Bokashi composting.

3.1. Cost of Composting

Within Onsite composting, the most expensive is the Bokashi bran. This is because it is too difficult to make it by ourselves and the researcher needs to buy it from a shop. For the offsite composting, labor cost the most fee. For the onsite composting, the economic cost per kg of food waste under 100 times used for onsite composting is $0.29. This number is calculated by finding the unit price of each item needed in the system, finding the quantity needed and calculating the total price. Since the goal is to calculate the cost per kg of food waste composting, and there is the

assumption that the item's life cycle are 100 times using, the total price needs to be divided by 800 (8kg food waste/bucket * 100 times using). There are many items that need to be used in onsite composting, like spigot, bucket. But the prices are quite similar, they are all within the range of $0.001-0.004 except Bokashi bran.

Table 2: Cost and CO_2 Emission of Onsite. Composting [8][9][10][11][12][13][14][15][16][17][18][19][20][21][22].

Item	Quantity	Amount (Kg)	Cost per Item ($)	Cost per Kg of Food Waste) (Under 100 Times)	CO_2e Emission per Item (Kg CO_2e/Kg or /Km)	CO_2e Emission per Kg of Food Waste (Kg CO_2e/Kg or /Km)
Bucket (PET)	2	1.940	5.00	0.0125	2.55	0.006
Spigot (PET)	1	0.029	3.50	0.004375	2.55	0.0001
Bokashi bran - plastic bag (LDPE)	0.02	0.020	13.04	0.2608	6.00	0.0002
Bokashi bran - molasses (sugar)	0.07	0.070	13.04	0.2608	0.27	0.005
Bokashi bran - (wheat bran)	0.03	0.030	13.04	0.2608	0.56	0.001
Plate (ceramics)	1	0.490	3.00	0.00375	1.22	0.001
Jar (PET)	1	0.062	1.50	0.001875	2.55	0.00007
Metal cover of jar (Aluminum)	1	0.020	1.50	0.001875	21.60	0.001
Gloves (LDPE)	1	0.013	0.09	0.01125	6.00	0.000002
Paper box (of gloves) (paper)	1	0.035	0.09	0.01125	1.23	0.00004
Total	/		/	**0.2946**		**0.01400**

In Table 2, since the researcher needs to build her own onsite composting system, the CO_2e produced by products manufacture like spigot and buckets needs to be calculated. While Table 3 shows the offsite method of transporting waste to the factory for processing, which mainly shows the CO_2e generated from waste storage and transportation. It is worth mentioning that Table 3 contains a potential cost because offsite composting lacks a fertilizer produce compared to onsite, so the school needs to purchase additional fertilizer.

Table 3: Cost and CO_2 Emission of Offsite Composting with Purchase of Composted Fertilizer [18][19][20][23][24][25][26][27][28].

Item	Quantity	Amount	Unit for Amount	Cost per Item ($)	Cost per Kg of Food Waste) (Under 100 Times)	CO_2e Emission per Item (Kg CO_2e/Kg or /Km)	CO_2e Emission per Kg of Food Waste (Kg CO_2e/Kg or /Km)
Trash can (PET)	2	2.720	Kg	25.00	0.00119	2.55	0.00033
Bag (paper)	18	1.332	Kg	0.52	0.02229	1.23	0.00070
Transportation	2	28.60	Km	39.50	0.09405	0.25	0.03439
Labor	3		$	150.00	0.1071	/	/
Total					**0.2247**		**0.035**
Generated fertilizer							

Potential purified fertilizer	12.1	12.1	g	12.25	0.1531	5.60	0.012
Potential diluted fertilizer	3	11.37	L	1.75	0.06563	/	/
Potential plastic bottle per gallon of water	1	0.02	Kg	0.02	0.000025	2.55	0.000
Total	/			/	**0.2187**		0.012

Also, there is a potential benefit of onsite composting that the final purified fertilizer can be used at school. Since then, school doesn't need to buy other fertilizers. For offsite composting, the cost per kg of food waste is $0.2247. The total price of this composting can be found using the same method as onsite composting. However, when the food waste gets transported to the composting company, each truck carries about 420 kg of food waste. Therefore, the total price needs to be divided by 420. For items like trash can, it also has a life cycle for 100 times using, so the dividing number is 42000.

Transportation and labor fees are the largest economic costs for offsite composting. Based on the result, the offsite composting costs $0.07 lower per kg food waste than onsite composting. However, there is a potential cost for offsite composting for the fertilizer that needs to be bought additionally, which costs $0.2187 per 100 times. Though it costs more money for onsite composting to work, it is a small amount that should be affordable for schools. Consider the whole life cycle for the composting system, which is to use it 100 times, it only cost $218.7 difference. Also, when the solution of environmental problems causes conflict with economics, some compromise needs to be made.

3.2. Carbon Emission of Composting

Comparing the carbon emission, for the onsite composting, it causes 0.014 kg of CO_2e per kg of food waste, and for offsite composting the cost is 0.035 kg of CO_2e per kg of food waste. The researcher calculates the carbon emission by finding material that makes up the item, and search for unit emission for the material, then times the unit emission with total weight of item. The difference again happens on the dividing number: for onsite composting, the dividing number is 800 and for offsite composting, the dividing number is either 420 or 42000.

The environmental benefits brought by onsite composting is clear. It leads to a reduction of 21 g of CO_2e per kg of food waste composting compared with offsite composting. This difference is mainly caused by the transportation process for offsite composting. The carbon emission for transporting is 0.034 kg of CO_2e, which takes up nearly 98% of total emission for offsite composting. The emission only count for transportation is higher than the total emission for onsite composting. Therefore, switching from offsite to onsite composing would result in a reduction of 21 kg of CO_2e for 1000 kg of food waste, which is the amount of waste produced by a high school campus with 400 people within just about five days to a week. It is worth knowing that 21 g of CO_2e is the number of CO_2 that can be redacted by a mature tree for a whole year [29].

3.3. Recommendations for School Waste Composting

Based on the experiment results, there are some recommendations that can be made to schools who plan to compost their food waste. First, because of the evident finding of the onsite composting's environmental benefits, if economic conditions allow, conducting more onsite composting causes less CO_2 emission than offsite composting. However, if offsite composting is the only choice, choosing a place that is near the waste origin would be a good choice since the transportation causes the majority of the CO_2 emission through the entire process. There is another exception that when the Bokashi

bran and buckets need to be transported to the school, reconsider if it causes a huge amount of emission that is greater than offsite. Because some product may need to be transported from a long distance away that may cause even more emission.

4. Conclusion

Composting is one of the most popular topics people talk about to process food waste. To help organizations like schools to find the most beneficial way to do their composting, this essay helps evaluate the economic and environmental cost for onsite and offsite composting. By doing an onsite composting experiment and finding data, the researcher calculates the unit economic cost and carbon emission for both ways. Eventually, the researcher calculated the cost per kg of food waste for onsite composting as $0.29, while the cost for offsite composting is $0.22 (a 24% reduction). The environmental costs, though, are 0.014 kg of CO_2e per kg of food waste for onsite composting and 0.035 kg of CO_2e for offsite composting.

Clearly, the environmental cost of onsite composting is lower than offsite. However, the tradeoff is that the monetary cost for onsite composting is higher than offsite composting. But the impact of onsite composting can be profound: high schools can utilize the produced fertilizer onsite for its plants, reduce carbon emission, and engage students and faculty to sustainable living and environmental protection. To further improve this study, researchers can increase the complexity of the evaluation model and consider conditions that fit to specific school or office sites. Still, school administrators can use the model of this case study to easily evaluate the economic and environmental costs of the two kinds of composting and make rational and sustainable composting plans accordingly.

References

[1] NBCNews. "The White House Is Going Green? Again." https://www.nbcnews.com/id/wbna29944122.

[2] Epstein, Eliot. The Science of Composting. Lancaster, PA: Technomic Publishing, 1997.

[3] Carbon Balance and Management. https://cbmjournal.biomedcentral.com/articles/10.1186/1750-0680-5-3.

[4] Callis, Steve."AnotherShortHistoryofComposting."Compostingfundation. https: // www. compostfoundation. org/ Portals/ 2/Documents/Another%20Short%20History%20of%20Composting-1.pdf.

[5] USDA. https://www.usda.gov/foodwaste/faqsIn.

[6] Cui Jiaying, Qingyin Dong, Jinhui Li, and Lili Liu. "Research on the Management Mechanism and Experience of 'Zero Waste' Construction in the United States." Unpublished manuscript, Qinghua, Beijing, China, July 1, 2022. Accessed July 6, 2022. http://www.zjepc.com/oa/DArticle.aspx?type=view&id=202203021.

[7] Mitchell, Marisa. "On-site Composting of Restaurant Organic Waste: Economic, Ecological, and Social Costs and Benefits." Berkeley. https://nature.berkeley.edu/classes/es196/projects/2001final/Mitchell.pdf.

[8] Tomberlin, K., Venditti, R., and Yao, Y. (2020). "Life cycle carbon footprint analysis of pulp and paper grades in the United States using production-line-based data and integration," BioRes. 15(2), 3899-3914.

[9] Gao, F., Nie, Z., Wang, Z. et al. Greenhouse gas emissions and reduction potential of primary aluminum production in China. Sci. China Ser. E-Technol. Sci. 52, 2161–2166 (2009). https://doi.org/10.1007/s11431-009-0165-6

[10] Amazon.https://www.amazon.com/Lanzeuta-BPA-Free-Replacement-Dispenser Reusable/ dp/ B08ZSFMQ37/ ref= asc_ df_B08ZSFMQ37/?tag=hyprod-20&linkCode= df0&hvadid= 507966100015&hvpos= &hvnetw= g&hvrand= 28502265000548364 36&hvpone=&hvptwo=&hvqmt=&hvdev=c&hvdvcmdl=&hvlocint=&hvlocphy=9031937&hvtar gid=pla-1277556680288&th=1.

[11] Amazon.https://www.amazon.com/Novelinks-Ounce-Clear-Plastic-Black/dp/ B07QKJD1F3/ ref=sr_ 1_ 1_ sspa? keywords=plastic+jar&qid=1655069364&sr=8-1-spons&psc= 1&spLa= ZW5jcnlwdGVkUXVhbGlmaWVy PUExRjh TNU1aOUs3Rko3JmVuY3J5cHRlZElkPUEwNTUwOTUzM1NLWkw2VVlOM1Y3WCZlbmNyeXB0ZWRBZElkPUEwNT czMTQ4M0JSSjRYWkdRRzFHVCZ3aWRnZXROYW1lPXNwX2F0ZiZhY3Rpb249Y2xpY2tSZWRpcmVjdCZkb05vdExvZ 0NsaWNrPXRydWU=.

[12] Amazon.https://www.amazon.com/Lanzeuta-BPA-Free-Replacement-Dispenser-Reusable/ dp/ B08ZSFMQ37/ ref= asc_ df_B08ZSFMQ37/?tag=hyprod-20&linkCode= df0&hvadid= 507966100015&hvpos= &hvnetw= g&hvrand=2 8502265000548364 36&hvpone=&hvptwo=&hvqmt=&hvdev=c&hvdvcmdl=&hvlocint=&hvlocphy=9031937&hvtargi d=pla-1277556680288&th=1.

*[13] Amazon.https://www.amazon.com/Gallon-Outdoor-Liners-Contractor-Capacity/ dp/ B0746MWFWJ/ ref=asc_ df_*

B0746MWFWJ/?tag=hyprod-20&linkCode= df0&hvadid= 216559542401&hvpos= &hvnetw= g&hvrand= 9112806443316732874&hvpone=&hvptwo=&hvqmt=&hvdev=c&hvdvcmdl=&hvlocint=&hvlocphy=9031937&hvtargid=pla-350654893809&psc=1.
[14] Amazon.https://www.amazon.com/SCD-Probiotics-Seasons-Bokashi-Innoculant/ dp/ B000UPQGAI/ref= asc_ df_ B000UPQGAI/?tag=&linkCode=df0&hvadid=416949847877&hvpos=&hvnetw=g&hvrand=4168782456364907432 &hvpone=&hvptwo=&hvqmt=&hvdev=c&hvdvcmdl=&hvlocint=&hvlocphy=9031937&hvtargid=pla-871390705881&ref= &adgrpid=94694114075&th=1.
[15] Dayaratne, Sampath, and Kennedy Gunawardana. "Carbon Footprint Reduction: A Critical Study of Rubber Production in Small and Medium Scale Enterprises in Sri Lanka." SSRN, March 21, 2017. https: // papers. ssrn. com/ sol3/ papers.cfm?abstract_id=2931966.
[16] Carycompany.https://www.thecarycompany.com/5-gallon-natural-plastic-pail-57wp5n? utm_s ource= google_ shopping&gclid=CjwKCAjwnZaVBhA6EiwAVVyv9OIWsFf1Iu1zFmfl12_fyrwxSoUBNVRcr0RTtGb2TIr6IdGXFjrLoho CrpMQAvD_BwE.
[17] Healable. https://www.healabel.com/wheat-bran/.
[18] Rahim, Razuana, and Abdul Aziz Abdul raman. "Carbon Dioxide Emission Reduction through Cleaner Production Strategies in a Recycled Plastic Resins Producing Plant." Journal of Cleaner Production 141 (January 2017): 1067-73. https://doi.org/10.1016/j.jclepro.2016.09.023.
[19] Juerg. Juerg to Timeforchange web forum, "Plastic Bags and Plastic Bottles? CO2 Emissions during Their Lifetime." https://timeforchange.org/plastic-bags-and-plastic-bottles-CO2-emissions-during-their-lifetime/.
[20]Rubio-Domingo, Gabriela, and Amit Halevi. "Making Plastics Emissions Transparent." COMET. Last modified February 2022. https://ccsi.columbia.edu/sites/default/files/content/COMET-making-plastics-emissions-transparent.pdf.
[21]Peng, Junxia, Yubo Zhao, Lihua Jiao, Weimin Zheng, and Lu Zeng. "CO2 Emission Calculation and Reduction Options in Ceramic Tile Manufacture-the Foshan Case." Energy Procedia 16 (2012): 467-76. https: // doi. org/ 10. 1016/ j. egypro.2012.01.076.
[22]Safeway.https://www.safeway.com/shop/product-details. 108200440. html? storeId= 2453&preference= PICKUP&cmpid=ps_swy_noc_ecom_goo_20211007_71700000087415712_58700007438894652_92700066835577014&gclid=CjwKCAjwwo-WBhAMEiwAV4dybWjjTqHV75XMHa6Ky9ZN_aKUnV-znsMbye15SsqXV3cuvaa8fZH7PxoC-0cQAvD_BwE&gclsrc=aw.ds.
[23] Smoot, Grace. "What Is the Carbon Footprint of Diesel Fuel? A Life-Cycle Assessment." Ninja. https: // impactful. ninja/ the-carbon-footprint-of-diesel-fuel/.
[24] Yara. https://www.yara.com/crop-nutrition/why-fertilizer/environment/fertilizer-life-cycle/.
[25]ULine. https://www.uline.com/Product/Detail/H-1853BL/Brute-Trash-Cans-and-Accessories/Rubbermaid-Brute-Trash-Can-10-Gallon-Black?pricode=WA9045&gadtype=pla&id=H-1853BL&gclid=Cj0KCQjwwJuVBhCAARIsAOPwGAQBstPT4ZwymCM2GBl7xqPHh2hfwKKGqDYKffJ21T1pkfA926qG4HEaAqiDEALw_wcB&gclsrc=aw.ds.
[26]Flourishplant.https://flourishplant.com/products/all-purpose-plant-food? variant= 42210870460582&currency= USD&utm_medium=product_sync&utm_source=google&utm_content=sag_organic&utm_campaign=sag_organic&utm_campaign=gs-2022-04-26&utm_source=google&utm_medium=smart_campaign&gclid=CjwKCAjwwo-WBhAM EiwAV4dybYaiM5OY7lbl_ yys0273nxMbr-qi9j7PzFlv40j7VAGol1JwI3s9NRoCwQMQAvD_BwE
[27] U.S Department of Energy. AFDC. Last modified August 2015. https://afdc.energy.gov/files/u/publication
[28] WeShield.https://www.amazon.com/Novelinks-Ounce-Clear-Plastic-Black/ dp/ B07QKJD1F3/ ref= sr_ 1_ 1_ sspa? keywords=plastic+jar&qid=1655069364&sr=8-1-spons&psc= 1&spLa= ZW5jcnlwdGVk UXVhbGlma WVyPUEx RjhTNU1aOUs3Rko3JmVuY3J5cHRlZElkPUEwNTUwOTUzM1NLWkw2VVlOM1Y3WCZlbmNyeXB0ZWRBZElkPUEwNTczMTQ4M0JSSjRYWkdRRzFHVCZ3aWRnZXROYW1lPXNwX2F0ZiZhY3Rpb249Y2xpY2tSZWRpcmVjdCZkb05vdExvZ0NsaWNrPXRydWU=.
[29] Stancil, Joanna Mounce. "The Power of One Tree - the Very Air We Breathe." USDA (blog). Entry posted March 17, 2015. https://www.usda.gov/media/blog/2015/03/17/power-one-tree-very-air-we-breathe.