



Sunfleck Consulting, LLC

Agroforestry Systems | Forest Management

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The farm plan at D'Artagnan Farms Foundation's All One One All includes a variety of perennial and annual plants, planted between June and September of 2020.

The full plan includes:

- 222 fruit trees
- 351 fruiting shrubs
- 94 vines
- 1000 small trees to harvest leaves for livestock feed ("fodder shrubs")
- Vegetable gardens totaling .32 acres

Each plant needs the equivalent of one inch of rainfall per week (or, 144 cubic inches [.62 gallons] of water per square foot). The plants occupy 1.70 acres (based on a 6-foot row width for fruit trees, shrubs, vines, and a 4-foot row for fodder shrubs). The rows of pasture between the trees are not irrigated.

Throughout the growing season, April through October (210 days), the average weekly precipitation is .96 inches¹ (.137 inches per day). In the record-dry year (2001, which was the driest year since 1965), the average weekly precipitation was .67 inches² (.095 inches per day).

The roof area of buildings on the farm is approximately 7000 square feet. In an average rainfall year, collecting rainwater for irrigation will yield 4188 gallons of water per week, (average of 598 gallons per day) which means **the farm will be able to meet its daily water needs with a surplus of 332 gallons per day.**

The upshot:

- In an average year, averaged over 365 days, the plants on the farm will require supplemental irrigation of (266 gal/growing season day x 210 days /365 days) 153 gallons per day. When rooftop rainwater collection is installed, the farm will collect an average of 598 gallons per day, which will add (598 gal/growing season day x 210 days /365 days) 344 gallons per day over the entire year. **This will fully cover the irrigation needs of the plantings on the farm, on an average basis.**
- In an above-average year (statistically, 50% of the years are above average), the plants will require less irrigation than the average scenario, and likely **not use supplemental irrigation at all.**
- In a record dry year, the farm will require (2201 x 210 / 365) 1266 gallons per day. When rooftop rainwater collection is installed, the farm will collect an average of 415 gallons per day, which will add (415 gal/day x 210 days /365 days) 239 gallons per day over the entire year. The remaining water deficit for a record dry year will be 1027 gallons per day over the entire year. **This represents a worst-case scenario that is statistically very unlikely. In addition, this estimated worst case deficit is covered three fold by the farms wastewater management system in tandem with a 5,000 gallon water storage tank.**

These numbers represent the high end of water use estimates. Over the course of the five-year establishment period, the plantings will require significantly less water. See the following water demand schedule where demands decrease 75% and 50% for some classes of plants in years 3-5.

Daily Irrigation Water Demand by Year (365-day Average), Gallons

	2021	2022	2023	2024	2025
Average year	153	153	112	105	91
Average year, with rainwater collection	0	0	0	0	0
50-year drought	1266	1266	925	871	754
50-year drought, with rainwater collection	1027	1027	686	632	515

1 Weather.com historical rainfall data for Goshen, NY:

<https://weather.com/weather/monthly/1/394d122a2a3a139ca91e865e9c2ded6116f2be78b04f50a762cb5996f6a45721>

2 NOAA National Centers for Environmental information, Climate at a Glance: Global Mapping, published September 2020, retrieved on September 23, 2020 from <https://www.ncdc.noaa.gov/cag/>

The farm is primarily composed of Mardin gravelly silt loam soils, which are classified as moderately well-drained. Soil organic matter levels are mostly between three and four percent, though one section measured over five percent. We expect the water holding capacity of the soil to increase over the next five years due higher soil carbon levels from compost application, careful rotational grazing management, and the deep-rooted perennial plants breaking up compaction in subsoil layers. An increase of 0.1% soil organic matter per year is a very conservative estimate. This will improve the trees' ability to weather in inevitable fluctuations in precipitation, and improve the water-holding and infiltration capacity of the soil.

The farm is laid out in a combination of *alley cropping* and *silvopasture* patterns, which integrate rows of trees with cultivated land and grazing areas. They are spaced intentionally so that the trees intercept rainfall, provide leaf litter for soil improvement, and intercept nutrient runoff from the manure of the animals. The tree rows are purposefully designed to approximate the contour of the land, which means a water droplet will not travel more than 6 feet without meeting an area with perennial vegetative cover. The only exception to this is the garden area, where the maximum distance a droplet will travel before hitting perennial cover is 36 feet. If a raindrop falls on the highest point of the farm, it will have to flow over 20 raised beds and 20 pasture strips before running off at the farm's lowest point.

In the farm's production plan, over 95% of the farm's cropping area will remain under perennial cover at any given time. In short, it is reasonable to expect that the farm will retain and infiltrate over 90% of water that it uses, whether through rainfall or irrigation.

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