Agroforestry In Vermont: Will the implementation of agroforests help Vermont's freshwater systems, increase SOM, and sequester more carbon?

Alexis Blair Colantuno
Plant and Soil Science Department at the University of Vermont, Burlington, VT, USA

INTRODUCTION

Background:

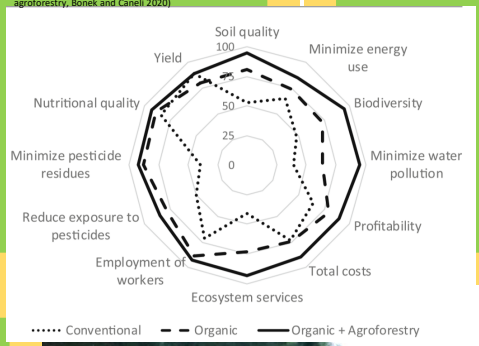
As climate change affects agriculture (Borek and Canali 2020), farmers are looking for ways to adapt and become more sustainable. Agroforestry is thought to be a new champion of sustainable ag, and can be simplified to be described as treed crop or livestock systems. The practice of agroforestry is fairly common in the tropics on coffee plantations and the like, but here in Vermont, there is a slower acceptance to the practice.

Motivation:

As Vermont's landscapes begin to change we need to find alternative agricultural practices that will benefit the farmer and the land (Bambo et al. 2009). Agroforestry has it's place in Vermont's rocky and sandy farm lands. With the future droughts and extreme weather farmers will need a level of new product diversification, livestock sheltering, and an increase in SOM to bolster the soil moisture.

We propose that the use of agroforests on Vermont's landscapes will better protect the farmer, the land, and the lake.

Figure 1: The comparison of conventional, organic, and agroforestry, Bonek and Caneli 2020)



STUDY DESIGN

I propose a study that will look over a minimum of 6 Vermont farms, 2 of each kind of farm systems (ie. 2 silvopstural trials, 2 agroforestry crop trials, 2 agroforest and silvopasture trials), each trial will have a control field. The control will be open field or conventional/organic means of management-no change to their current systems. For each farm we will need monthly satellite photos, GIS landscaping data, typography data for each field, ratio of treed to field initially and post agroforestry introduction. From the point of the study onwards there will also need to be a report from the farmers on the amount of water they used to irrigate, the amount of fertilizer used over the period of the season, and the amount of pesticides used over the course of the study.

Once the 6 farms have their trial fields, a total of 4 fields at each farm, if applicable for a total of 24 fields. From there we will take the measurements of initial soil moisture, soil organic matter, soil organic carbon, root mass (using the methods expressed in Ong et al 1998), and initial lysimeter readings. Our initial soil moisture will be taken at 2 depths, one at 6 inches and the second at 12, if there is a plow pan that should be noted, the rest of the soil samples should be taken in the traditional Z pattern and a minimum of 12 soil cores should be taken in each field. These readings will be taken once a week for the first initial year then once every four weeks for the next two years. For each season there will be additional testing at the exact plots at the time of fertilizer (which will be exact and the same for each farm and trial plot), the initial data will be recorded, then subsequently 24 hours after the fertilizer, then again 72 hours after fertilization to asses the spread of the fertilizer through each system.

As this study goes on there will be qualitative data being collected from the farmer. We will inquire about the labor that goes into the treed fields, their impressions of it's efficiency or helpfulness or lack there of, and to analyze if treed goods add economic stability/diversification. This study does nothing if the farmer doesn't believe or feels burdened by the addition of agroforests.

Figure 3: Each farming system. Open field, silvopasture, agroforest, agroforest with only crop.

PROJECTIONS

Hypothesis; We hypothesize that there is a positive relationship between SOM, water retention, nutrient stabilization and carbon sequestration when you introduce a tree crop into a Vermont field.

Predictions; We predict that in time the leaf litter and root exudates will increase biodiversity and make healthier soils with richer organic matter. The trees will also provide a wind break and decrease soil erosion as well as shelter from harsh weather for both crop and livestock alike. All of these factors should assist in creating higher yields, crops with higher nutrition for forage crops, and introduce a diversification to both the landscape and the farmers products.

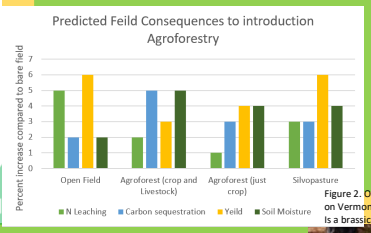


Figure 2. Our predictions on the effects of agroforestry on Vermont's soils and their expected yields. The crop is a brassica and the livestock is sheep.

Future Studies; This study will be the first of many. The subsequent studies should be to analyze and create more pathways for farmers to engage in adaptive management tools.

https://www.aces.edu/wp-content/uploads/2018/10/Silvopasture-Chipley-FL-1-09-045.jpg

ANALYSIS

Tools to Analyze; For this project we will be analyzing the different field systems with ANOVA. We will also be conducting LER, Land equivalent ratios, for each farm. When we are able to weigh the statistically significant data with the amount of land needed to achieve positive outcomes for both the land and the farmer we can then look deeper into each system to see what could be improved or the factors that made it so successful.

Benefits; Integrating agroforestry into Vermont's farming systems will take time, but they will be instrumental in helping farms adapt to a changing climate. Treed fields in Vermont can add sugarbush to traditionally grazed land, increase agritourism and ecotourism, and hopefully help find funding for these practices.

Future Uses; We are hopeful that the results of this study will influence future policy to bolster these farming practices, educating extension services, and helping Vermont farmers find a relief in the diversity rather than a burden.

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