Will Fuchs
CSC 490

Project Outline

Deliverable

I will be writing a linear programming model to optimize the planting and irrigation of my home garden. I'll be using 5-7 plants, three different light configurations (shade, part shade, sun), and three different water inputs (greywater, rainwater, and tap water). There are three classes of constraints in this problem: the gardener imposed constraints, ecological constraints, and biologically imposed constraints. Gardener imposed constraints would be things like not watering root vegetables with greywater and setting minimum yields for each crop. Ecological constraints are things like minimum amount of carbon sequestered in the soil and maximum amount of tap water used. Biologically imposed constraints are things like not planting certain plants together, and not planting certain plants in the shade. Once the model is set up I can do sensitivity analysis on the more variable inputs, such as rainfall and crop yield.

Architecture

I will either write a script that reads in a file full of vegetable models and a file full of gardener constraints and then generates an AMPL file for that model, or write it all in AMPL, I am not sure yet. I'll have to learn more about what is possible with AMPL first.

Learning Objectives

From this project, I hope to learn about reducing real world problems to linear programming models. I expect there to be a lot of complexity in the sun/shade part of the constraints, because each pant can shade the plants north of it.

Resources

The main resource for the yields and companion planting constraints is *How to Grow More Vegetables, Ninth Edition*. Although not in a scientific journal, it is a comprehensive guide to growing a biointensive garden, which is what this optimizer seeks to generate. The yields per plant are also experimentally derived over almost a decade of research.

For soil organic carbon and nitrogen data, I am using the paper *Building up the soil carbon pool via the cultivation of green manure crops in the Loess Plateau of China*.

I will also be looking at scientific papers detailing the nutrient uptake needs for all of the plants that I pick. These needs will be taken into account when the soil constraints are set up and the change in soil quality after a growing season is calculated. If I have time, this data would also be pertinent to a crop rotation planner.