User Manual

I. Introduction

This computer software application is a tool that aims to aid farmers and gardening enthusiasts alike in generating and optimizing their chosen crop-livestock system. It has been developed to automatically generate systems of crop/s and/or livestock/s that are mutually beneficial to each other in terms of cycling necessary nutrients that are needed in maintaining healthy crops as well as increasing the pest management capabilities of the user's chosen system.

II. Choosing components for Generating Crop-livestock System/s

A. Choosing Season and Habitat

The user has 12 choices in filtering for crop/s and/or livestock/s that are compatible in the season the user chooses as well as the type of habitat in which their crops are cultivated and livestock are integrated in. These filtration options differentiate by 4 seasons and 2 types of habitats. The 4 seasons are spring, summer, fall and winter in which users can base their chosen temperature as such:

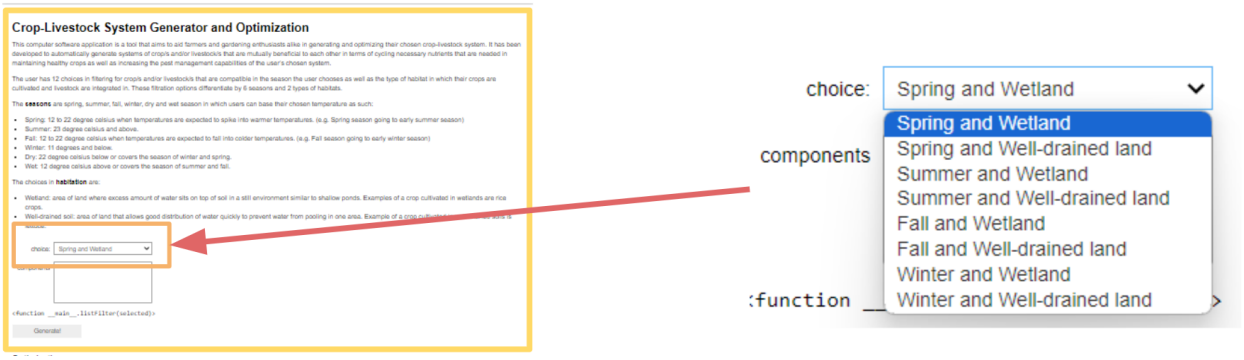
- Spring: 12 to 22 degree celsius when temperatures are expected to spike into warmer temperatures. (e.g. Spring season going to early summer season)
- Summer: 23 degrees celsius and above.
- Fall: 12 to 22 degrees celsius when temperatures are expected to fall into colder temperatures. (e.g. Fall season going to early winter season)
- Winter: 11 degrees and below.
- Dry: 22 degree celsius below or covers the season of winter and spring.
- Wet: 12 degree celsius above or covers the season of summer and fall.

The choices in habitation are:

- Wetland: area of land where excess amount of water sits on top of soil in a still environment similar to shallow ponds. Examples of a crop cultivated in wetlands are rice crops.
- Well-drained soil: area of land that allows good distribution of water quickly to prevent water from pooling in one area. Example of a crop cultivated in well-drained soils is lettuce.

The steps of choosing a filtering option are as follows:

1. Identify the current temperature in your area or estimated temperature in the period in which you plan your crop-livestock system. You may use equipment such as thermometers or use applications in your phone or computer. Please refer to the guide for temperatures above to know which season fits your situation.
2. Choose a habitat that you shall be using in setting your crop-livestock system. Refer to the guide for habitats to know which habitat fits your situation.
3. After identifying the equivalent season for your desired temperature as well as identifying the habitat you wish to cultivate crops and/or raise animals, you may choose from the options on the dropdown selection similar to the image below.

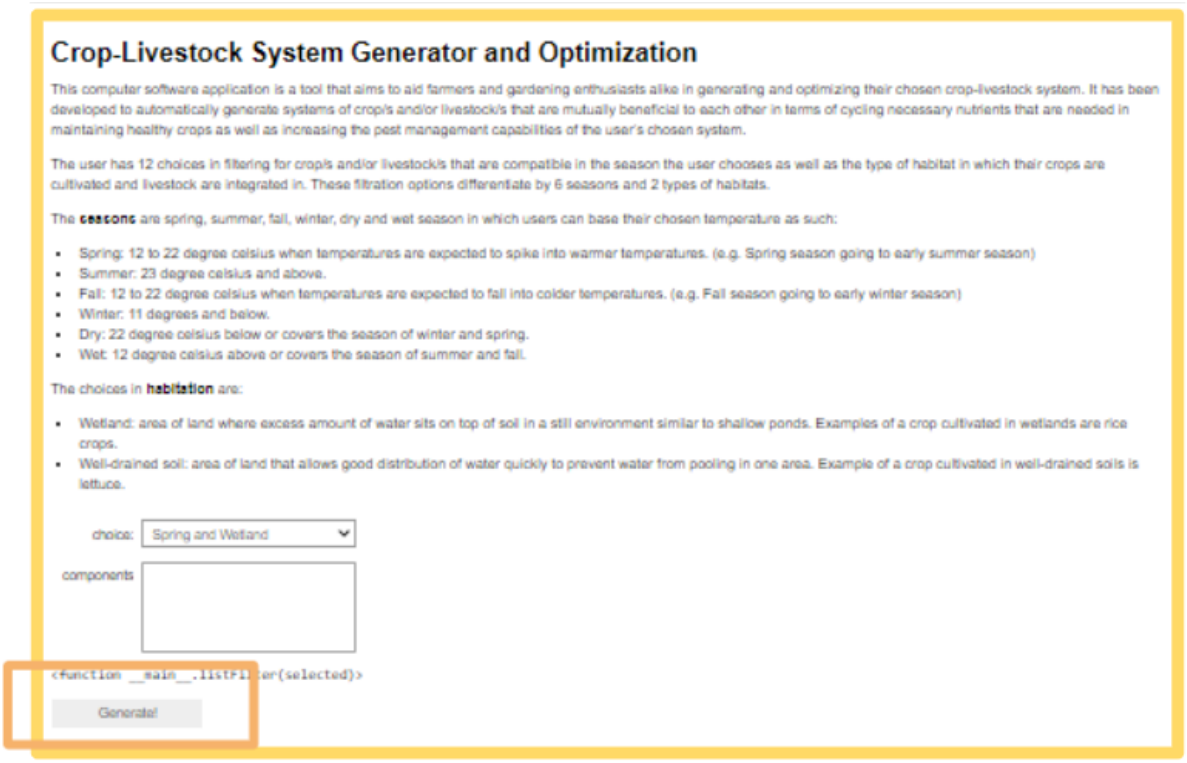


B. Choosing components

After the user's chosen filter, a list of crop/s and/or livestock/s will be seen on the components text selection area where the user may choose all or a selection of the listed items

The steps on choosing components to add to your crop-livestock system/s are as follows:

1. The user has different ways to selection their items:
    - The user may drag their mouse over top of their chosen selection and drag downwards to the bottom of their selection.
    - For items with gaps in between each item, the user may hold the Ctrl button of their keyboard and click over each desired item. Note: when scrolling through the list, release the Ctrl button. Click and hold the Ctrl button again when choosing. Items previously selected will not be unselected if done correctly.
2. After the user is done choosing, they may click on the Generate button on the bottom of the selection list to generate the graph of their selection.



C. Warnings and Errors

For events where the user may encounter some difficulties in maneuvering the web application, here are solutions and troubleshooting guidelines that the user may refer to:

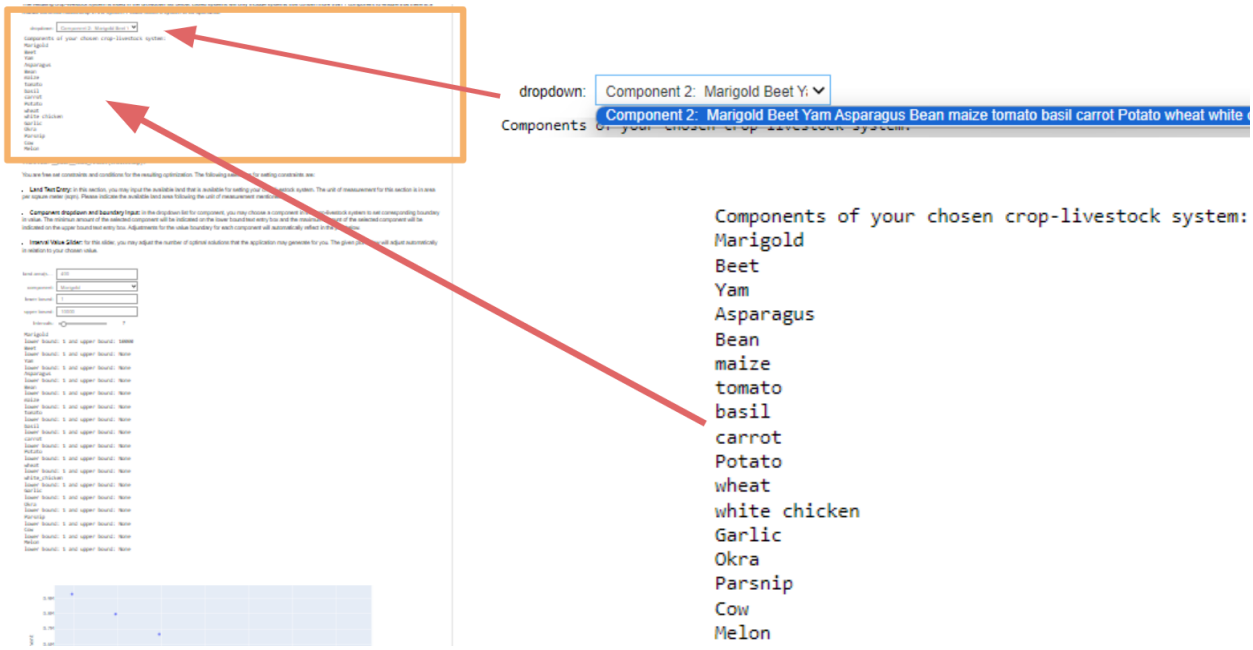
- In cases where the user has multiple graphs loading on their screen, they may refresh the page and enter their selection again.
- If some items selected by the user do not appear on the graph, it indicates that there are no present connections of that missing item on the other items presented in the graph.

III. Optimization of Chosen Crop-livestock System

A. Choosing resulting crop-livestock system/s

1. The resulting crop-livestock systems will be generated on the dropdown selection below where users are free to select their chosen system. Note: for systems consisting of only one component, it will not be included in the dropdown selection.

2. After selecting the system, a summary of components within the system will be displayed below.

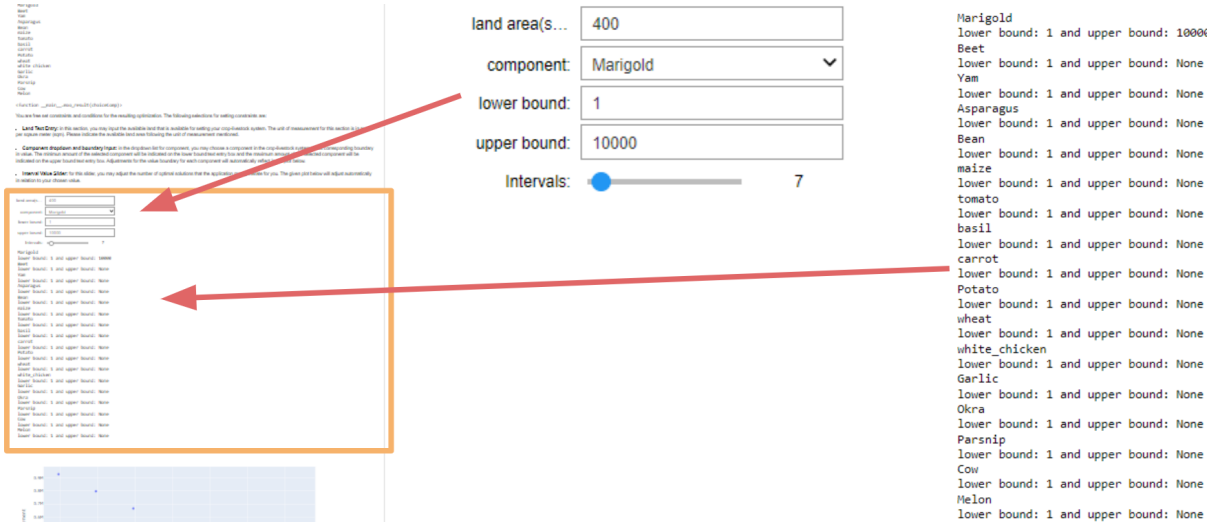


B. Setting constraints

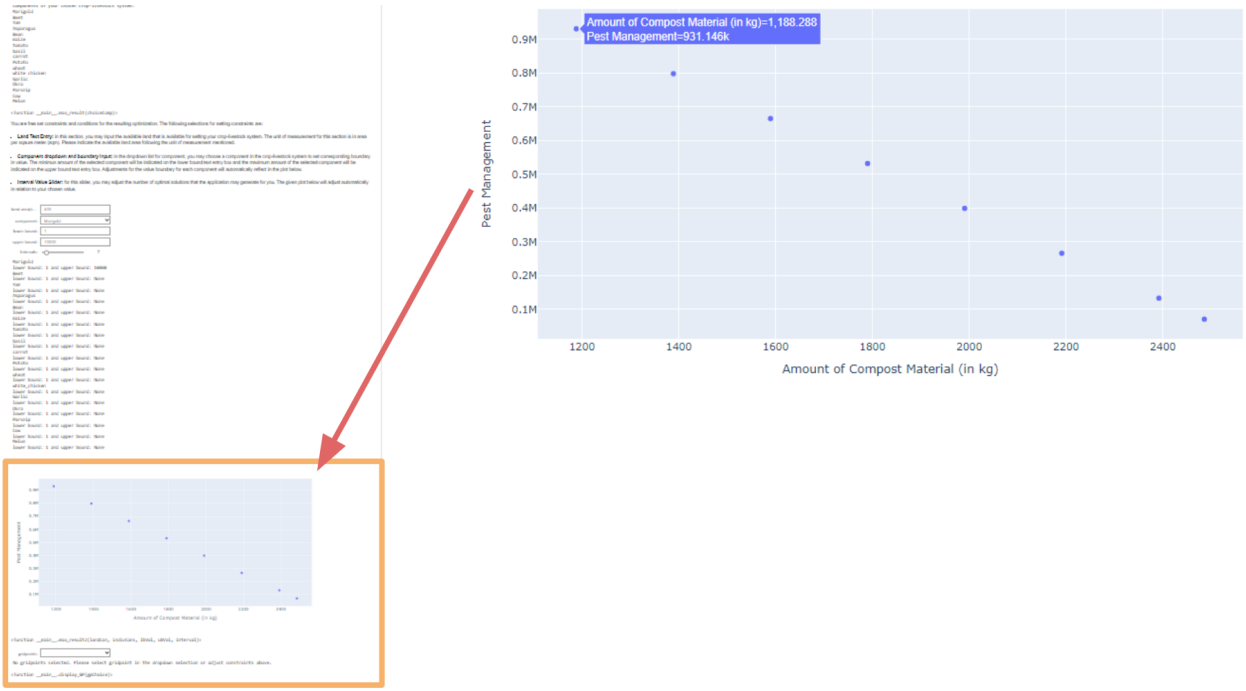
The user has different options in setting their constraints. These options are:

- Land constraint: the user may enter the land area that is available to them using square meters as their unit of measurement. They may enter the value in the text input available or opt to increase or decrease the value one unit at a time using the arrows on the right option of the text input.
- Component constraint: in the dropdown selection below, the user may choose a component in the system they choose to adjust constraint to. After selecting a component they may assign the minimum value in the lower bound text input and the maximum value in the upper bound text input.
- Interval: for the value slider, the user may adjust the intervals in between the solutions that will be available to the user. In increasing the interval, it will increase the solutions that the user may choose.

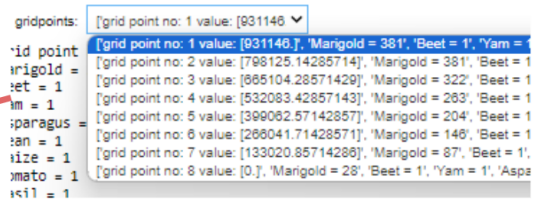
A summary of constraints set by the user will be displayed as seen in the image below.



The visualization of the solutions for the optimization problem will be automatically displayed for every adjustment the user makes to the constraints. The visualization will look like the image below. The user may also hover over their cursor to each point in the scatter plot to have an overview of the values for each objective function (Pest Management & Amount of Compost Material).



Once the user has chosen a solution that meets their needs, they may refer to the value of their chosen Pest Management objective when selecting the solution in the gridpoint dropdown selection (see image below). When selected, a summary of the values for each component will be displayed.


gridpoints:
['grid point no: 1 value: [931146
['grid point no: 1 value: [931146.]', 'Marigold = 381', 'Beet = 1', 'Yam =
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['grid point no: 6 value: [266041.71428571]', 'Marigold = 146', 'Beet = 1
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['grid point no: 8 value: [0.]', 'Marigold = 28', 'Beet = 1', 'Yam = 1', 'Aspa