Farm Vis - Visualizations for Record Keeping for Farmers

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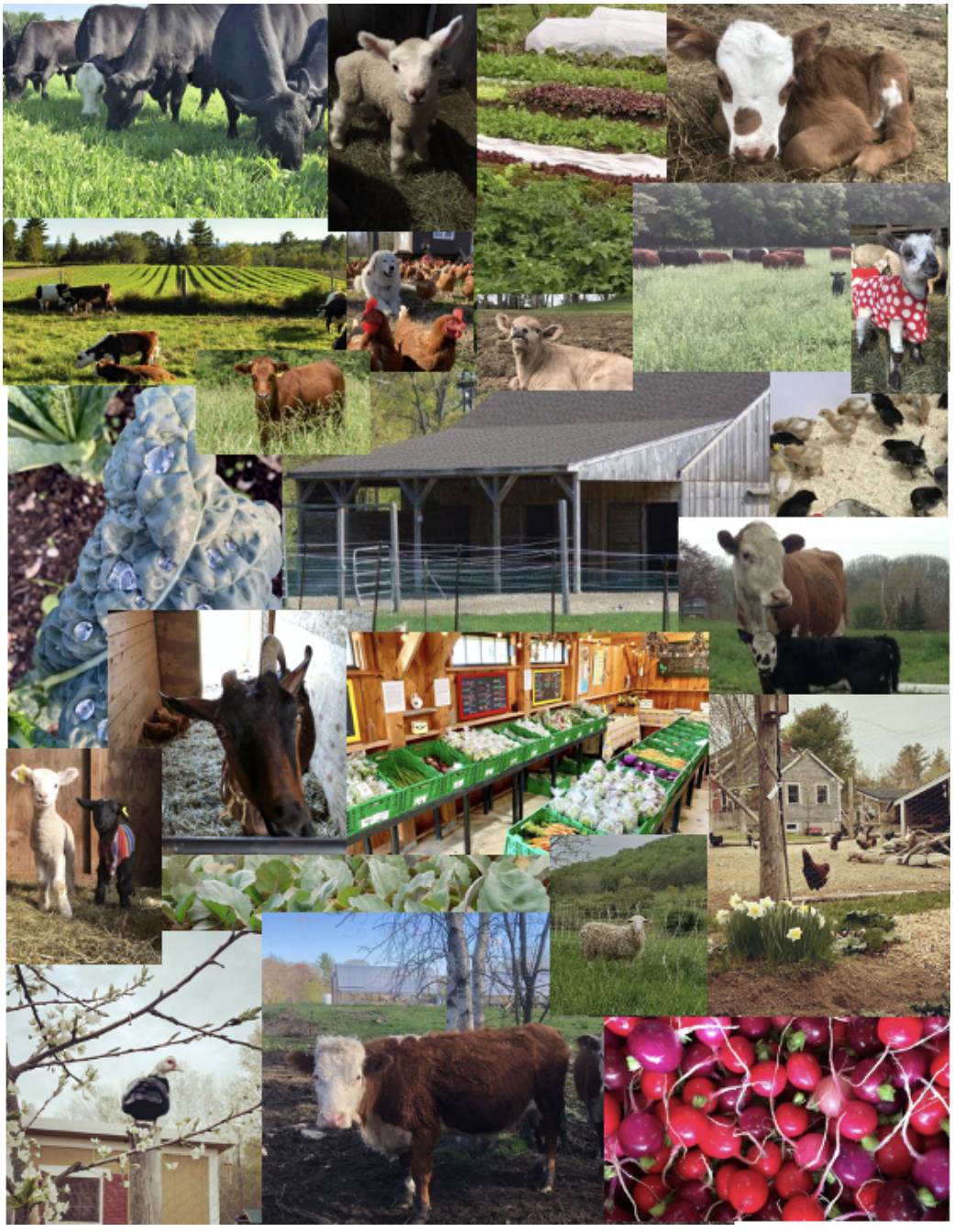


Overview and Motivation

Our project began with an interest in data visualizations in the field of agriculture and a connection to the developers and users of an existing record-keeping platform for farmers. From the course's weekly Reflections process it was evident that agriculture is an area where data visualization is sparse though data collection is broad and abundant.

Farmers record data every day; data that is important for the efficient and profitable management of their business. Record keeping methods have rapidly evolved from paper and pencil to integrated cloud based platforms. We were given access to one of the most comprehensive of these newly emerging tools.

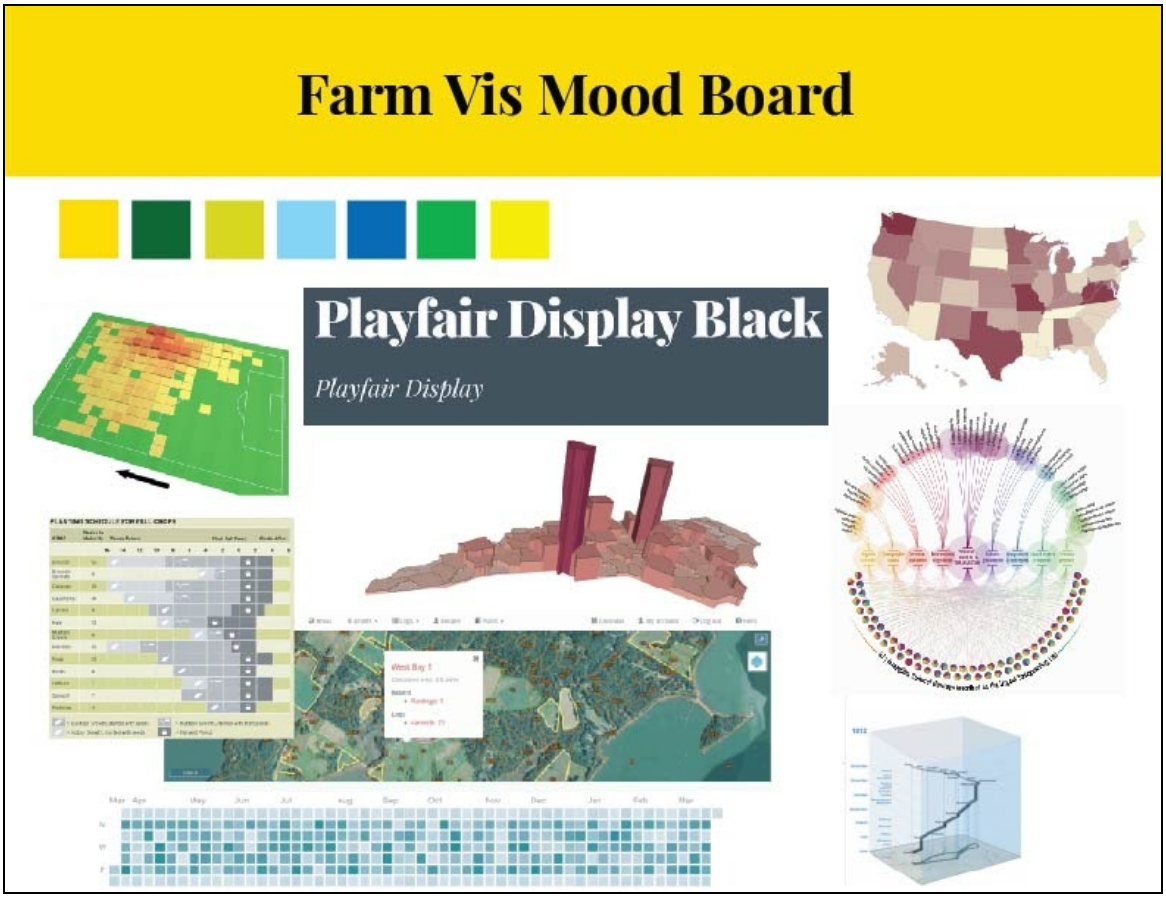
The motivation behind our project was that these platforms could benefit from interactive data visualizations, both to make it more enjoyable and to support data viewing and analysis. We decided to explore several prototypes based on our analysis of the data and feedback from users and developers of the farmOS platform.

The record-keeping platform is robust and pulls in all the data of interest to farmers in their day-to-day operations (see Data section). We participated in the platform's monthly call and posted to the message board. We used this input and an analysis of the data to generate ideas about what types of visualizations the users and developers of the platform would find useful and interesting.

Questions

Can we enhance existing data collection/record keeping tools for farmers with interesting and interactive visualizations?

Inspiration



Data

Data source was one of the challenges of this project. Though farmers are collecting lots of data, most of this data is privately held. There is public data available, from the USDA for example, but the project was more geared to farm-level data.

We were given access to a research farm account for the record keeping platform. The platform has the option to output most of this data to csv. The components of the data on the platform are the following:

<u>Assets</u>

- Subtypes of Assets
    - Plantings
    - Animals
    - Equipment
    - Sensors
    - Groups

- Variables of Assets
    - ID
    - Name
    - Type
    - Location
    - Group
    - Subtypes also have variables specific to them

Areas

- Assets
- History of Assets (list assets moved to the area)
- Logs by type
- geojson

People

- Roles
- Assigned logs

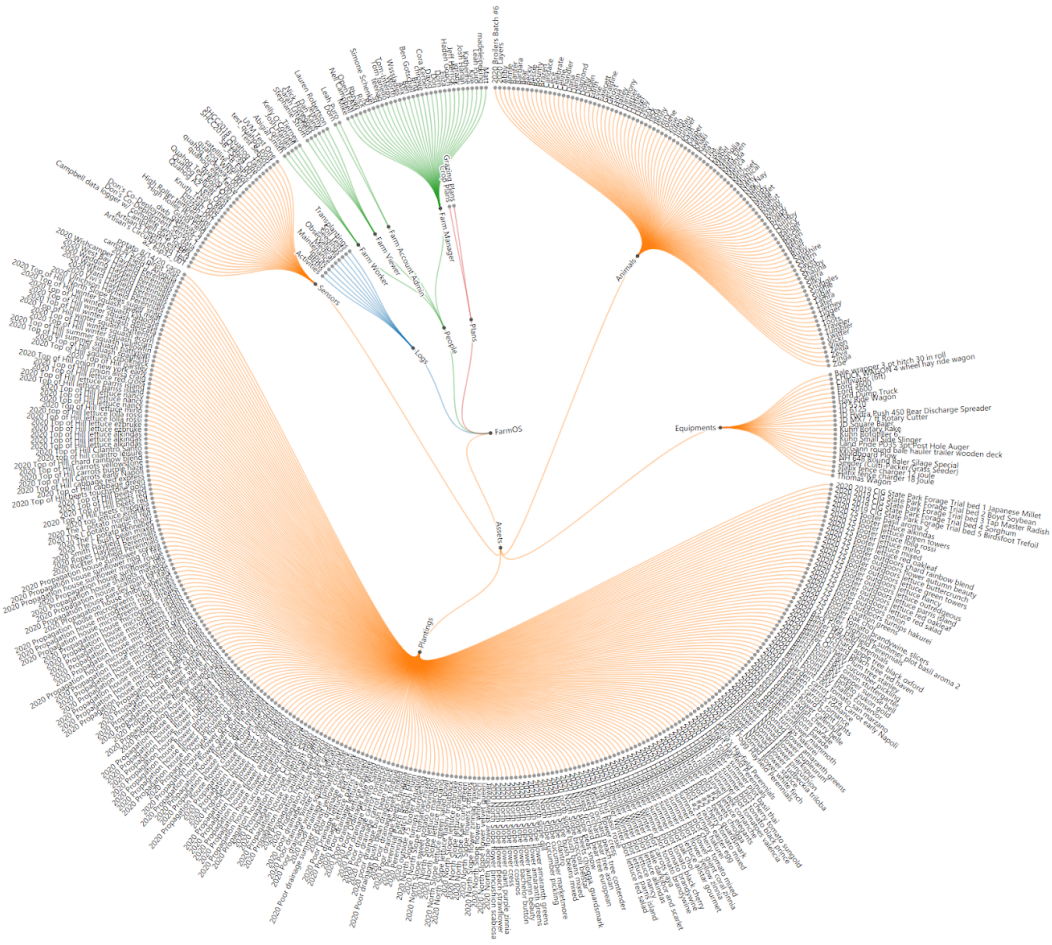
Logs

- Types of Logs
    - Activities
    - Births
    - Inputs
    - Maintenance
    - Medical
    - Observations
    - Seedings
    - Soil Tests
    - Transplantings
- Variables of Logs
    - ID
    - Date
    - Log name
    - Assets
    - Areas
    - Type
    - Categories
    - Assigned to
    - Specific types of logs have additional fields

For the choropleth map, the geojson data had to be cleaned up, particularly the name and id fields to make them more usable. We also made a new data file for this visualization for the log counts. In the logs the area was frequently noted but not in the area column. The geojson data also needed to be corrected using the turf.js library.

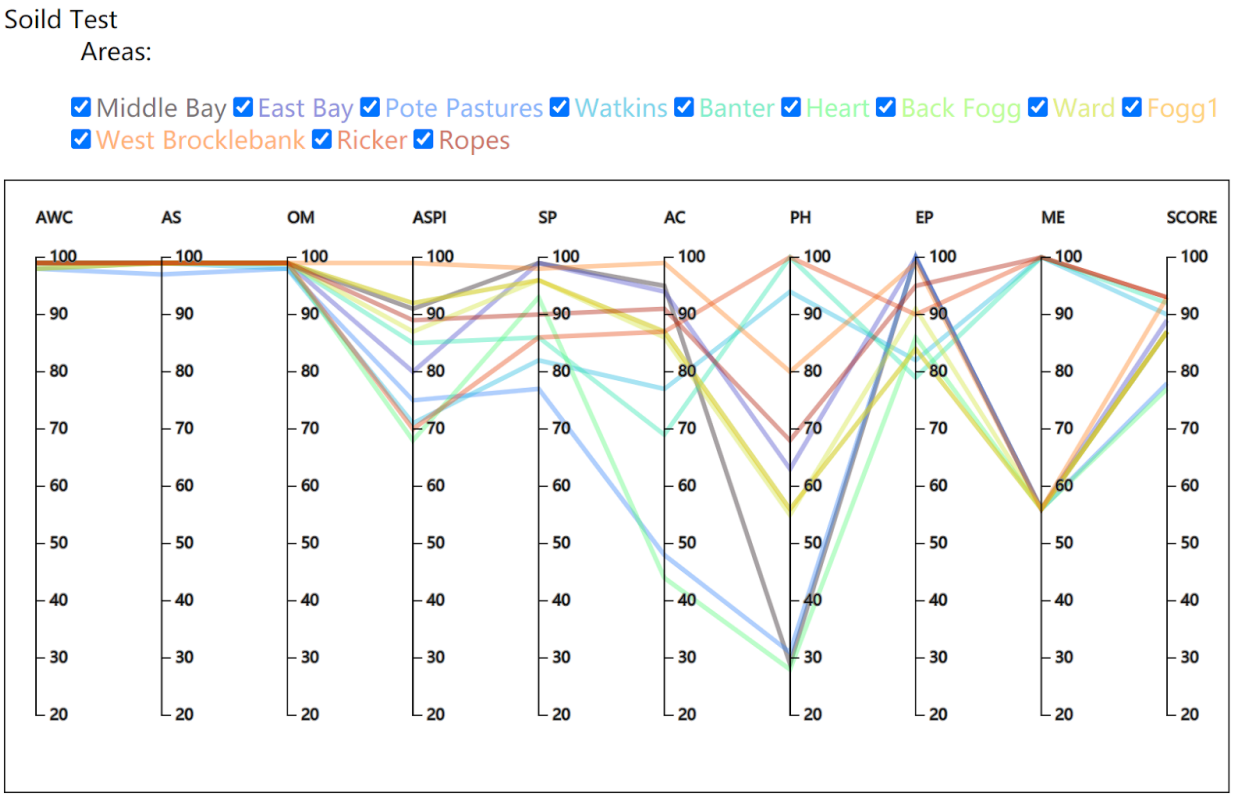
Implementation

Radial Tree:



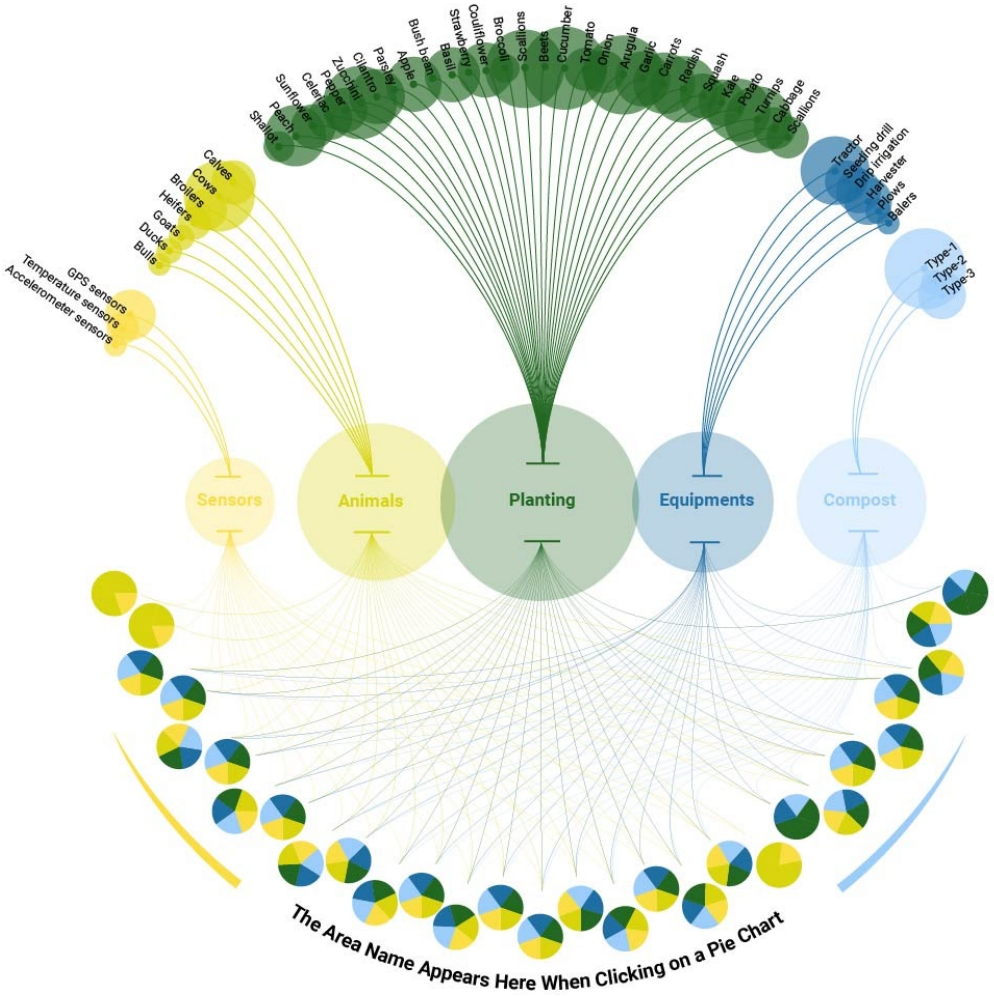
This visualization is a radial tree chart. It is good at showing data which has hierarchy structure. Compared to traditional tree charts, data of the same depth will be shown in the same radius, which makes it have more information density. The interaction of zoom and click are also added on the chart. Users not only can see the overview of the dataset structure but also can check specific data, starting at the platform level and showing the further depths of assets and details of each asset category.

Parallel Coordinates:



Our data included soil tests by farm area which evaluate the quality of the soil. Parallel coordinates are very suitable to show the areas in one chart. Users can compare them and find out which area has the best performance of one specific property. The chart also shows how the properties of the soil tests are related to each other. When Users put their mouse on the specific line, it will show the name of this area. When users put their mouse on the Abbreviation word, it will show the full word. Moreover, users can click the checkbox on the top of the chart to decide what areas to be shown on the screen.

Radial Assets Visualization:



This visualization is inspired by Nadieh Bremer's vis called "Threat" [1]. We designed it using Adobe Illustrator. It is for visualizing the farm's assets. The main structure of the vis is a network. The graph consists of pie charts of the farm's areas connected to circles in the middle representing the asset types. The asset types are connected to a group of circles in the last arc, representing a detailed asset list.

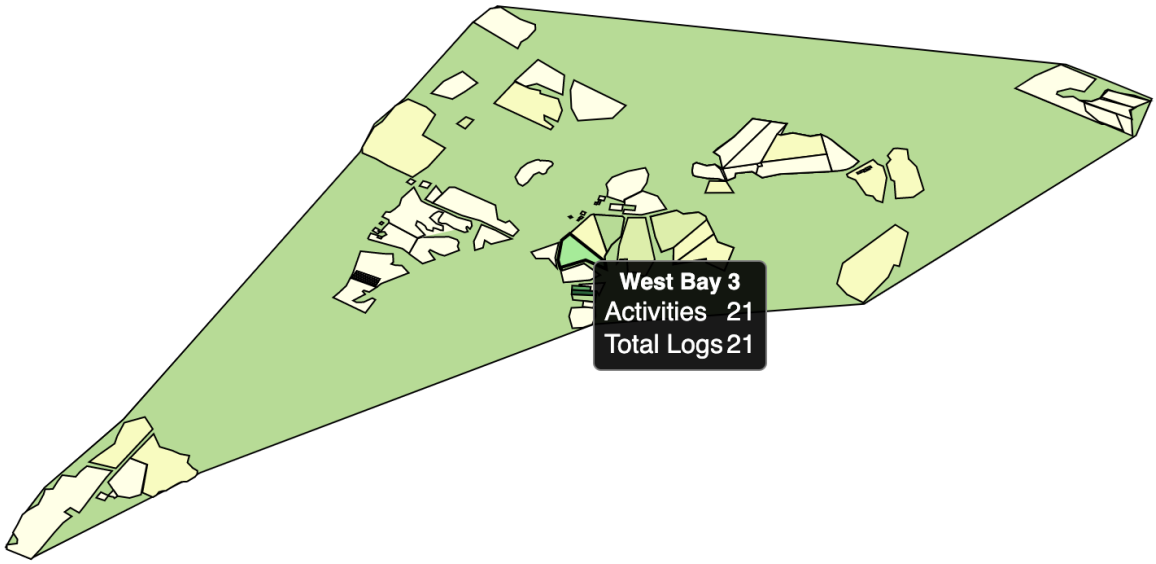
We categorize the asset type circles by color. Every pie chart is colored with all of the asset types' colors that are connected to. The circles are encoded by size.

The plan for this is to make it interactive. When the viewer hovers over each circle, it shows all of its connections. For example, if we hover over a pie chart, the area's name appears in the first arc along with connections to the asset types contained in that farm's area. Each of these types has a connection to the last upper arc, where it presents the details of that asset.

Radial Planting Timeline:

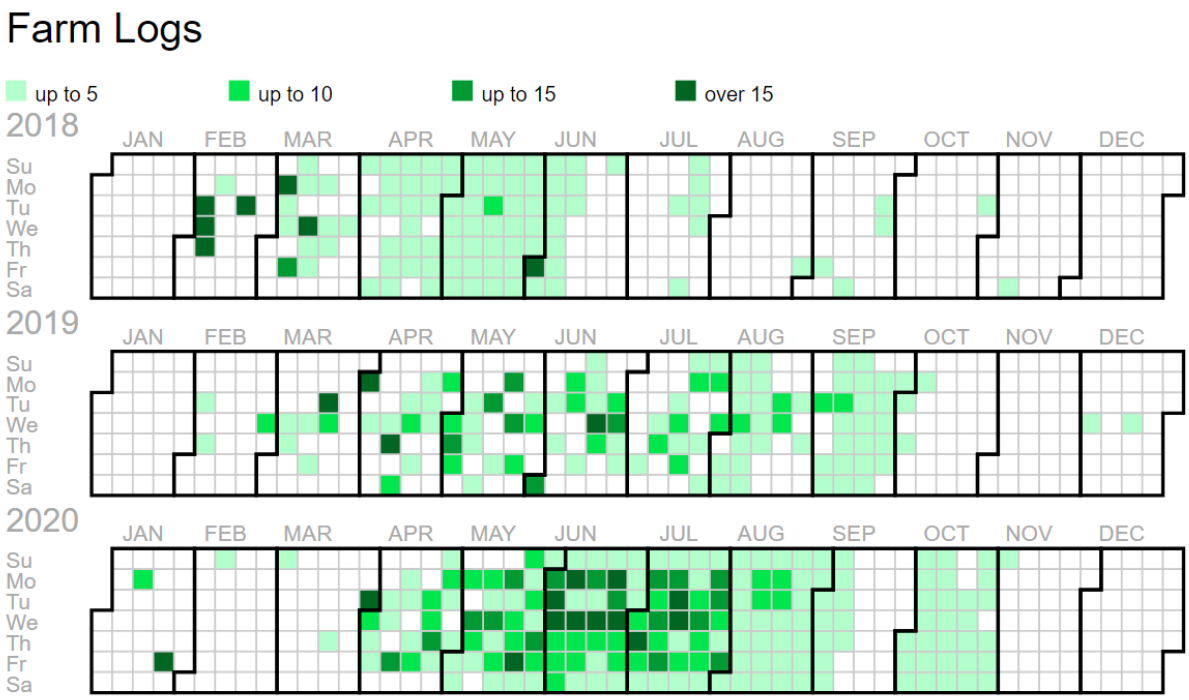
We designed this visualization using Adobe Illustrator. It is a radial planting timeline. Each line represents the planting time of a specific plant. Where the yellow part represents the growth period, and the green part represents the harvest period. The plan is to make this visualization interactive; so that when the viewer hovers over a plant line, a tooltip in the middle circle shows up. The tooltip presents details about that planting process, such as the plant name, farmer's name, seed/transplant date, and harvest date.

Logs by Area - Choropleth map



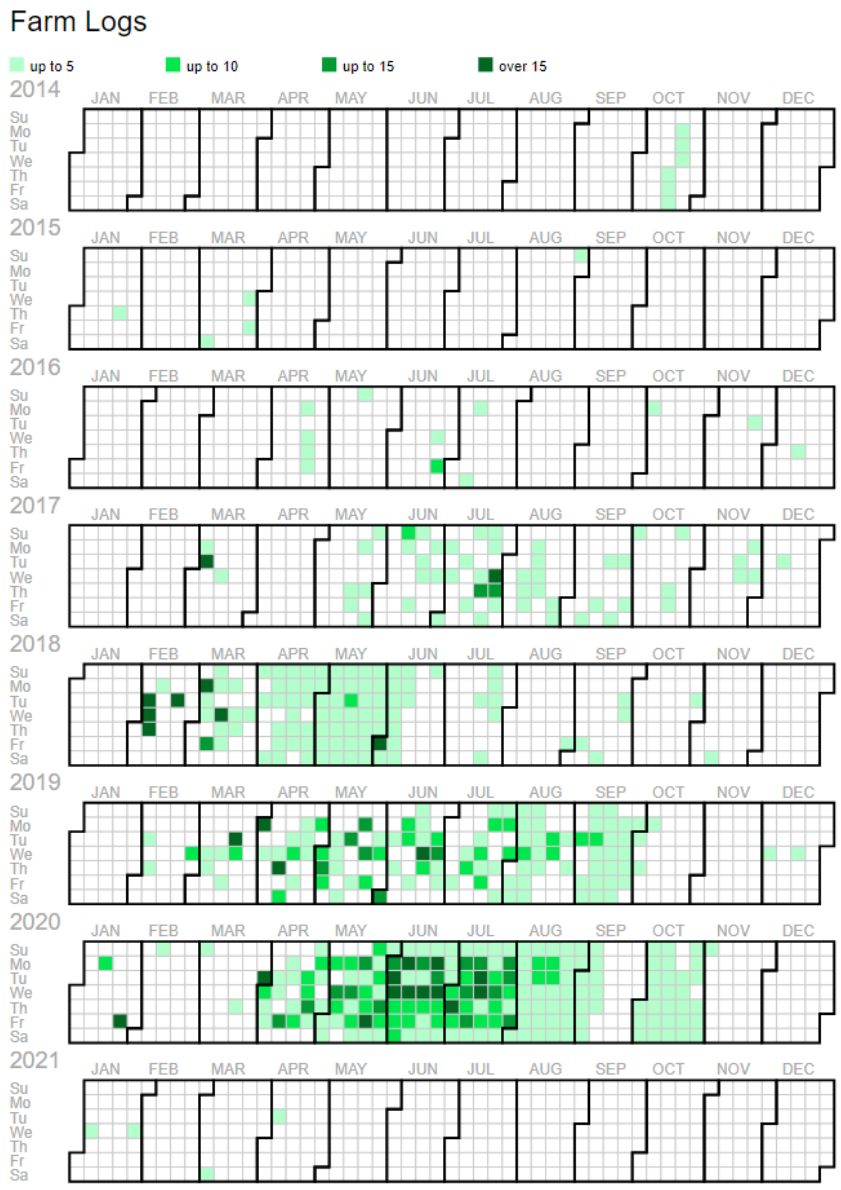
One requested visualization was a heatmap encoding number of logs by area of the farm. We decided it would be interesting to represent this data as a choropleth map with number of logs encoded by sequential color scale. We added interaction that highlights the area with mouseover and gives more details about the logs with a tooltip.

Calendar Heat Map:



This visualization is a calendar heat map showing the number of farm logs per day from 2018 to 2020. The days are color-coded depending on the number of logs per day. We added interaction that will show exactly how many logs occurred on each day with a mouseover.

The data shown in the visualization above (also on the website) is from the years 2018 - 2020 although we found data from 2014 through 2021. We made the decision to omit the data from 2014 - 2017 and 2021 because calendars created from those years were very sparsely populated as most of the data was concentrated in the range of 2018 - 2021. The visualization with the complete dataset is below:



Evaluation

Our project was successful in designing and implementing several visualizations related to the data that farmers collect on a day to day basis. We feel these visualizations met our goal of being useful and enjoyable for the data analysis tasks of farmers.

Future Work

With additional time we would pursue the following:

- Consult with users and developers of farm data management platforms for feedback on the utility of our designs for enhancing the platform.
- The choropleth map was envisioned as a choropleth prism map to dual encode number of logs by color and by height, and for visual interest. We would also add an onclick function that displayed additional details about the logs for a particular area. Visually it may have looked better with a background map or map tile in place of the bounding box but I could not figure out how to implement it.
- Adding additional interaction between the visualizations.
- Implementing our proposed designs that have been done by Adobe Illustrator
- Adding a filtering option to the calendar as this was requested by users.

References

1. https://ich.unesco.org/dive/threat/?language=en
2. https://www.d3-graph-gallery.com/graph/interactivity_tooltip.html
3. http://bl.ocks.org/NPashaP/a74faf20b492ad377312
4. https://observablehq.com/@mcmcclur/nc-covid-3d-choropleth
5. https://eagereyes.org/criticism/above-all-do-no-harm
6. https://github.com/DKirwan/calendar-heatmap
7. https://www.researchgate.net/publication/221025187_Geographic_Visualization/figures?lo=1
8. https://bl.ocks.org/alansmithy/6fd2625d3ba2b6c9ad48