

PSS Project Report

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I. Objective

The overarching goal of the project is to find the optimal perturbations to be made to get the best and most stable output possible for the Crop productions in the districts of Karnataka. (SDG2)

II. Contribution

- A. I have made 1-dimensional and 2-dimensional models that estimate and visualize the changes that a perturbation in one indicator could have on the capabilities, and the stability of the new value for each district.
- B. I made a visualization for Maternal Mortality Deaths in python.
- C. Made a Prescriptive model for Maize production similar to what was done for MMD previously. Took a target maize production and estimated the values of the factors needed, and visualized this in python.

III. Sprint report

- A. Sprint 1 : Initial Research and Tool Familiarization
 - 1. Start Date: 19/01/2024
 - 2. End Date: 25/01/2024
 - 3. Tasks Assigned:
 - a) Read the research papers regarding the project.

- b) Get a general idea of the work previously done and the tasks ahead.
 - c) Go through the usage of tableau, bokeh and any other visualization library that could be useful.
4. Tasks Done: All Done

B. Sprint 2 : 1D and 2D Stability Modeling and Visualization

- 1. Start Date: 24/01/24
- 2. End Date: 01/02/24
- 3. Tasks Assigned:
 - a) 1D stability modeling with the impact vs stability graph
 - b) If possible for 2D too
 - c) Visualizations for all capability vectors
 - d) Refine the Visualization of the adjacency graph
- 4. Tasks Done: All Done

C. Sprint 3: Expansion and Refinement of Stability Models

- 1. Start Date: 2/2/24
- 2. End Date: 8/2/24
- 3. Tasks Assigned:
 - a) Expanding the code to 2-Dimensional Capability Vectors along with the corresponding 'Impact vs Stability' Graphs
 - b) Going through Multiple Linear Regression
 - c) Refining the Impact vs Stability Graphs for 1-D
- 4. Tasks Done: All done

D. Sprint 4: Integration and Knowledge Transfer

- 1. Start Date: 8/2/24
- 2. End Date: 14/2/24
- 3. Tasks Assigned:
 - a) Combining the code made for automated 1D stability modeling with prescriptive modeling code made by Abraham.
 - b) Knowledge Transfer session with Abraham.
- 4. Tasks Done: All done

E. Sprint 5: Optimization of Impact vs Stability Plots

1. Start Date: 15/2/24
2. End Date: 21/2/24
3. Tasks Assigned:
 - a) Mostly worked on getting the best plots for Impact vs Stability for the MMD dataset, that included writing the code for calculating the stability and impact for all the districts for all the possible alpha (sensitivity) combinations.
4. Tasks Done: All done

F. Sprint 6: Multi-Dimensional Stability Code Fixes

1. Start Date: 29/2/24
2. End Date: 07/3/24
3. Tasks Assigned:
 - a) Fixing the code for stability for multi-dimensional Capability Vectors
4. Tasks Done: All done

G. Sprint 7 : Percentage Change vs Stability, 2D modeling

1. Start Date: 07/3/24
2. End Date: 14/3/24
3. Tasks Assigned:
 - a) Change the impact to Percentage change in the code, fix the corresponding 2-D visualizations
4. Tasks Done:
 - a) Finished the Visualizations for the 2D modeling for impact Vs Stability, four perturbations in a single plot, with avg lines and a legend.
 - b) Taking Min Max for all the four perturbations when calculating the impact. Got different values unlike the previous case.

H. Sprint 8: Prescriptive Model Adjustment and Visualization

1. Start Date: 21/3/24
2. End Date: 28/3/24

3. Tasks Assigned:
 - a) Change some of the factors in prescriptive modeling to get positive coefficients in linear regression.
 - b) Make visualizations for prescriptive model in tableau
4. Tasks Done: All done

I. Sprint 9: Expansion of Prescriptive Factors

1. Start Date: 4/4/24
2. End Date: 11/4/24
3. Tasks Assigned:
 - a) Change the factors for prescriptive from 4 to 7.
 - b) Compute the new values and visualize them.
4. Tasks Done: All done

J. Sprint 10 : Factor-Crop Ratio Implementation

1. Start Date: 18 /4/24
2. End Date: 25/4/24
3. Tasks Assigned:
 - a) Change the factors in 1D and 2D stability modeling, take FCR (factor-crop ratio) to get the portion of the factor resource used on the crop (estimated)
 - b) Change it similarly in Prescriptive modeling
4. Tasks Done: All done

IV. Sprint Summary

Sprint	Start Date	End Date	Title	Tasks Done
1	19/01/2024	25/01/2024	Initial Research and Tool Familiarization	All Done

2	24/01/2024	01/02/2024	1D and 2D Stability Modeling and Visualization	All Done
3	02/02/2024	08/02/2024	Expansion and Refinement of Stability Models	All Done
4	09/02/2024	14/02/2024	Integration and Knowledge Transfer	All Done
5	15/02/2024	21/02/2024	Optimization of Impact vs Stability Plots	All Done
6	29/02/2024	07/03/2024	Multi-Dimensional Stability Code Fixes	All Done
7	07/03/2024	14/03/2024	Percentage Change Modeling and Visualization	All Done
8	21/03/2024	28/03/2024	Prescriptive Model Adjustment and Visualization	All Done
9	04/04/2024	11/04/2024	Expansion of Prescriptive Factors	All Done
10	18/04/2024	25/04/2024	Factor-Crop Ratio Implementation	All Done

V. Source Code Details

1D and 2D Stability Modelling Link:

[https://github.com/Manish3693/WSL_PSS/blob/main/PE\(Main\).ipynb](https://github.com/Manish3693/WSL_PSS/blob/main/PE(Main).ipynb)

Maize Prescriptive:

https://github.com/Manish3693/WSL_PSS/blob/main/Maize_Prescriptive.ipynb

All the data needed for the first code are in the repository, Running it will generate the results and visualizations, but not store them. That can be done with a small line of code that is commented out if needed.

The data needed for the visualization in the second code is too big for github, running it after commenting out the first few code snippets that read the data, will generate the data, though it would take a long time depending on the system.

Once the data is generated, the visualizations will be generated too.

VI. Code structure

- ❖ PE(main) is the notebook that does the 1D and 2D stability modeling.
- ❖ Maize_Prescriptive is the notebook that does the prescriptive modeling for maize production.
- ❖ Rice_Maize_10_20_31_FCR is the excel file that contains the final result of the 2D stability modeling for Rice and Maize, with all the 31 districts and FCR applied for better accuracy.
- ❖ Sustainability_Score is an excel file that contains the sustainability scores for each of the perturbations for all the districts.
- ❖ Maizecasefile are the files that contain the factors and other needed columns for Prescriptive modeling of Maize production.
- ❖ Directory Tree (Only Essentials)

```
.
├── 2D Modelling Results
├── 2D Modelling Results with FCR
├── 2D Modelling Results with FCR.zip
├── 2D Modelling Results.zip
├── KAG 2016-17
├── Karnataka_District_Adjacency_File - Copy.xlsx
├── Karnataka_District_Adjacency_File.xlsx
├── Maize Prescriptive FCR Results
│   ├── Percentage Change (Zoomed).png
│   ├── Percentage Change.png
│   ├── Relative Change (Zoomed).png
│   └── Relative Change.png
```

- |— Maize Prescriptive FCR Results.zip
- |— Maize Prescriptive Results
 - |— Percentage Change (Zoomed).png
 - |— Percentage Change.png
 - |— Relative Change (Zoomed).png
 - |— Relative Change.png
- |— Maize Prescriptive Results.zip
- |— MaizeCaseFile.csv
- |— Maize_Prescriptive.ipynb
- |— PE(Main).ipynb
- |— PE_1.ipynb
- |— Sustainability_Scores.csv
- |— Sustainability_Scores.xlsx
- |— maizeProductionCaseFile.csv

VII. Libraries

Pandas, Matplotlib, Seaborn, Statsmodels, networkx, numpy, sklearn

VIII. System Requirements

Both the codes are jupyter notebooks, so other than installing all the required libraries, no other requirements are needed.

IX. Challenges Faced

- A. Not having Vijayanagara as a district in the dataset caused quite a few issues, sometimes we used the old data instead of the new data that we generated with it and results got skewed. Took some time to take care of it completely.
- B. Had a discrepancy in the plots. There were random lines in plot for prescriptive modeling, later found it was because some

numbers that python generated were not whole, in place of 6 it generated 6.005 for some reason. This caused the issue.

X. Talks given

My teammate Gramya and I gave presentations for the 3 project reviews.