Evaluating A New Treatment Assessment Methodology on the Productivity of Agricultural Fields in Nepal using Machine Learning Techniques and Space-Borne Data

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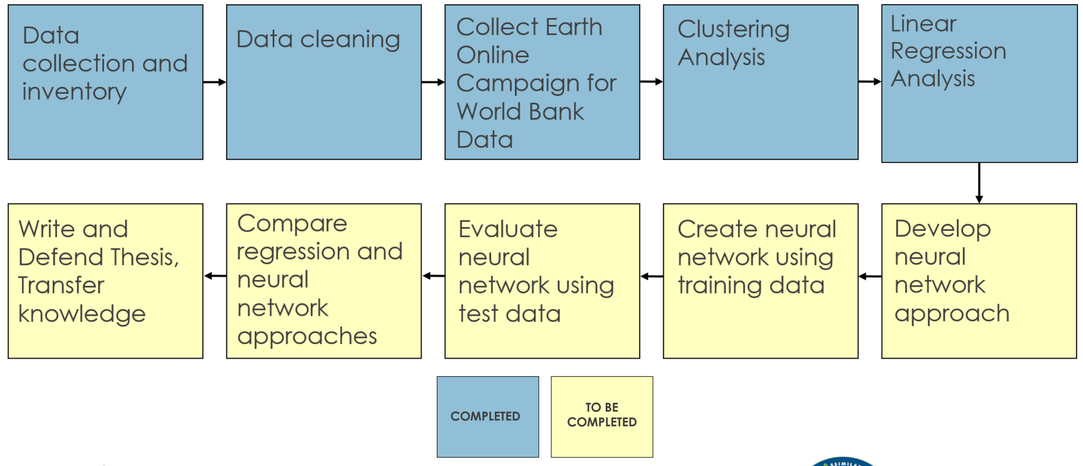
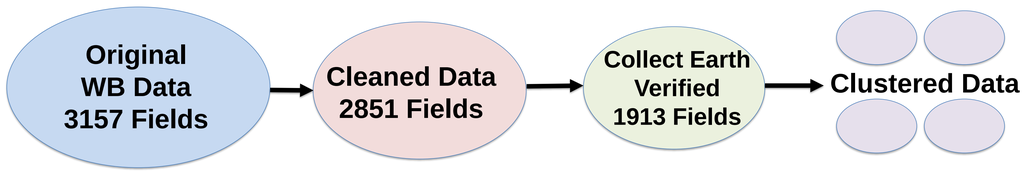
Overview/Introduction

- Food security is a major issue in Nepal in the face of a changing climate. Interventions into traditional agricultural practices, such as irrigation or improved seed varieties, are introduced with the overall goal of improving yield
- Assessing the impact of agricultural interventions is difficult for many reasons, including cost, time needed, remoteness of Nepalese countryside, and a lack of satellite imagery for analysis
- This research is an effort to develop a new impact evaluation approach that improves on traditional assessment methods, notably regression. This is done by **incorporating numerous space-borne datasets into a machine learning approach**
- This new methodology for assessing the impact of interventions on yield and the traditional method (regression) will be evaluated on their abilities to back-predict the Normalized Difference Vegetation Index (NDVI), serving as a proxy for yield in this study. The predictions of both studies will then be compared to the known NDVI derived from the satellite imagery

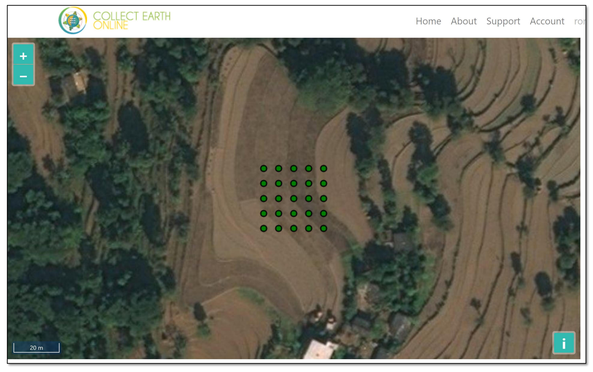
Methodology



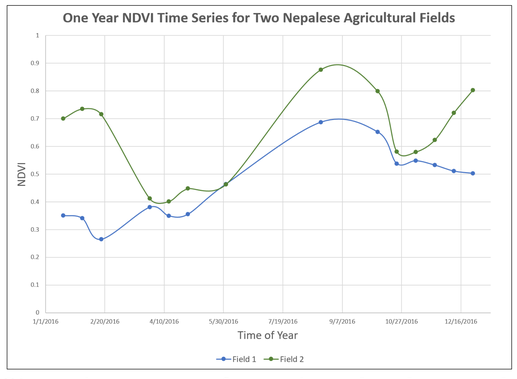
NASA Landsat Constellation · CHG Climate Hazards Group · DigitalGlobe · planet. · LDAS* · THE WORLD BANK



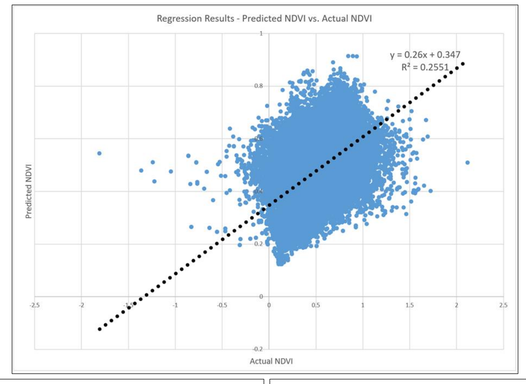
Results

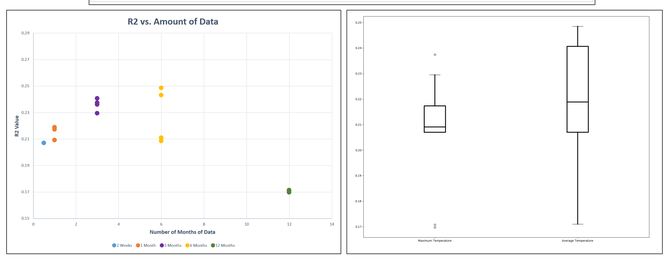


Collect Earth Online was used to verify the accuracy of the original field data, utilizing high resolution (1-3 meter) satellite imagery from Digital Globe, Bing, and Planet Labs.

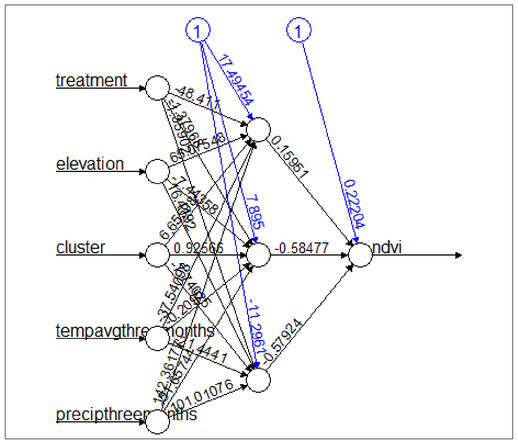


Clustering was performed on **the time series NDVI values acquired from the Landsat Constellation** for the remaining fields using Google Earth Engine and Python.





Stepwise linear regression was performed to predict NDVI biweekly from 2008-2018 using mean temperature, cumulative precipitation, treatment type, elevation, cluster, and month/year.



An artificial neural network (ANN) is in development to predict NDVI using the same input variables as the stepwise linear regression. The ANN learns the optimal weights for each input variable for prediction of NDVI. In this example, there are five inputs, one hidden layer, and three neurons in the hidden layer. There is also bias that is accounted for in the input layer as well as the hidden layer. All datasets are normalized between 0 and 1 prior to inclusion in the neural network.

Impact

- This approach **utilizes space-borne products and machine learning to improve** on past methodologies including regression for assessing agricultural interventions into traditional practices
- The next step in the research is to finish fine-tuning the neural network and compare the results of the artificial neural network to those of the stepwise linear regression
- The effectiveness of the new methodology will then be justifiable and has the potential to revolutionize agricultural intervention impact assessments in a region of need

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* South Asia Land Data Assimilation System (SALDAS) – Ben Zaitchik, Johns Hopkins University

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