Image Credit: Stanford University

Evaluating a new machine learning-based methodology for assessing the impact of agricultural interventions in Nepal

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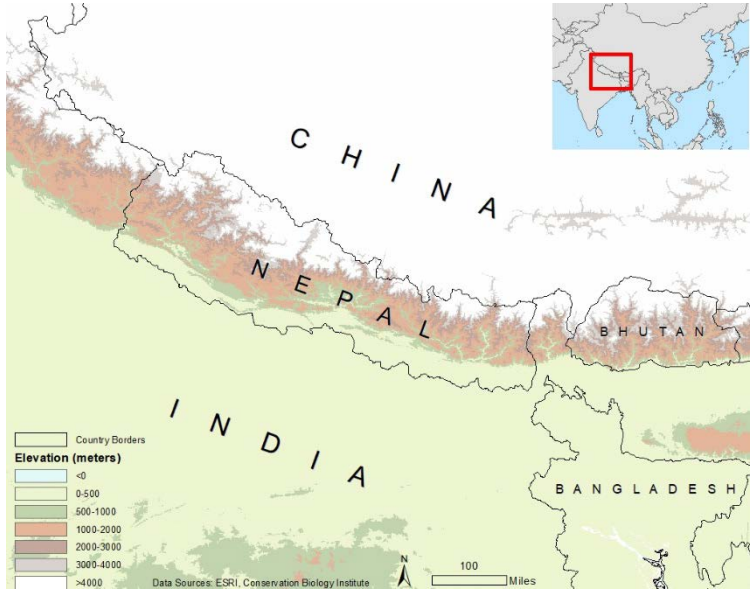
SERVIR connects space to village by helping developing countries use satellite data to address critical challenges in food security, water resources, weather and climate, land use, and natural disasters. A partnership of NASA, USAID, and leading technical organizations, SERVIR develops innovative solutions to improve livelihoods and foster self-reliance in Asia, Africa, and the Americas.

Background & Motivation

- Food security is a major issue in Nepal
- Agricultural interventions are performed with the goal of improving yield
- Assessing agricultural interventions is difficult for many reasons, including cost, time needed, and remoteness of the Nepalese countryside
- This research is an effort to develop a new impact evaluation approach that addresses the challenges of traditional assessment methods, improves on other contemporary methods, and builds off other ongoing initiatives



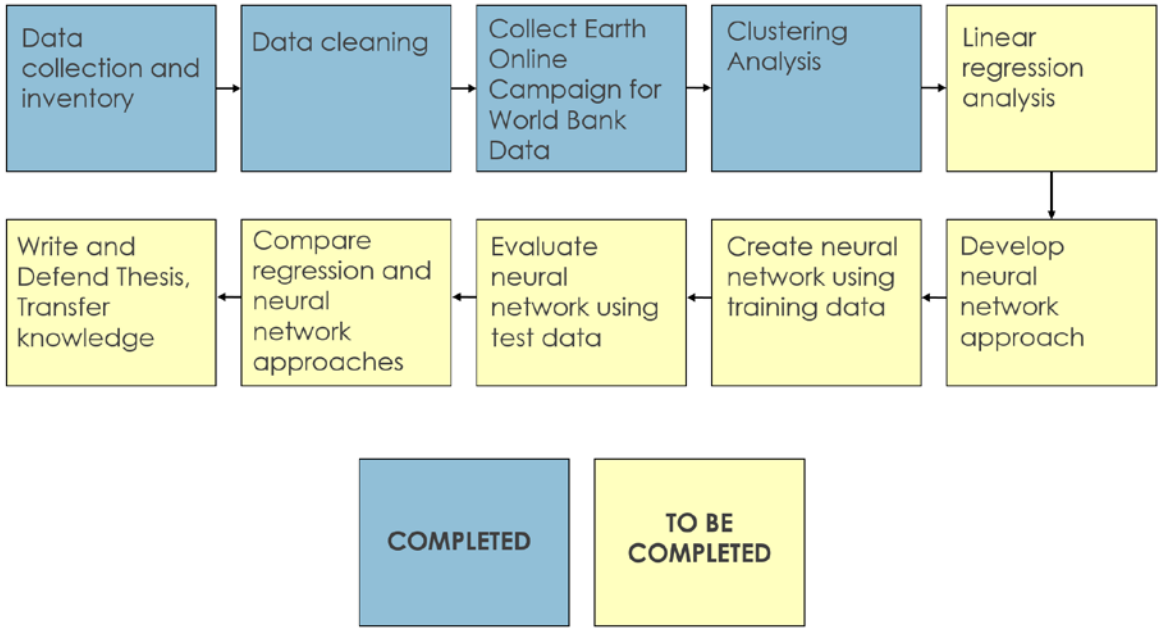
Location of Nepal

Traditional Harvesting of Wheat in Nepal
Credit: Nabin Baral, ICIMOD

Research Assumptions and Datasets

Research Question: Can machine learning improve on existing methods for predicting NDVI, used to detect changes in productivity as a way to assess intervention impact?

Methodology



Datasets

- Landsat constellation - back to 1980
  - **Calculate NDVI time series from Landsat imagery**
- CHIRPS precipitation – pentad, 5km, back to 1981
- World Bank field intervention dataset

planet.

DigitalGlobe

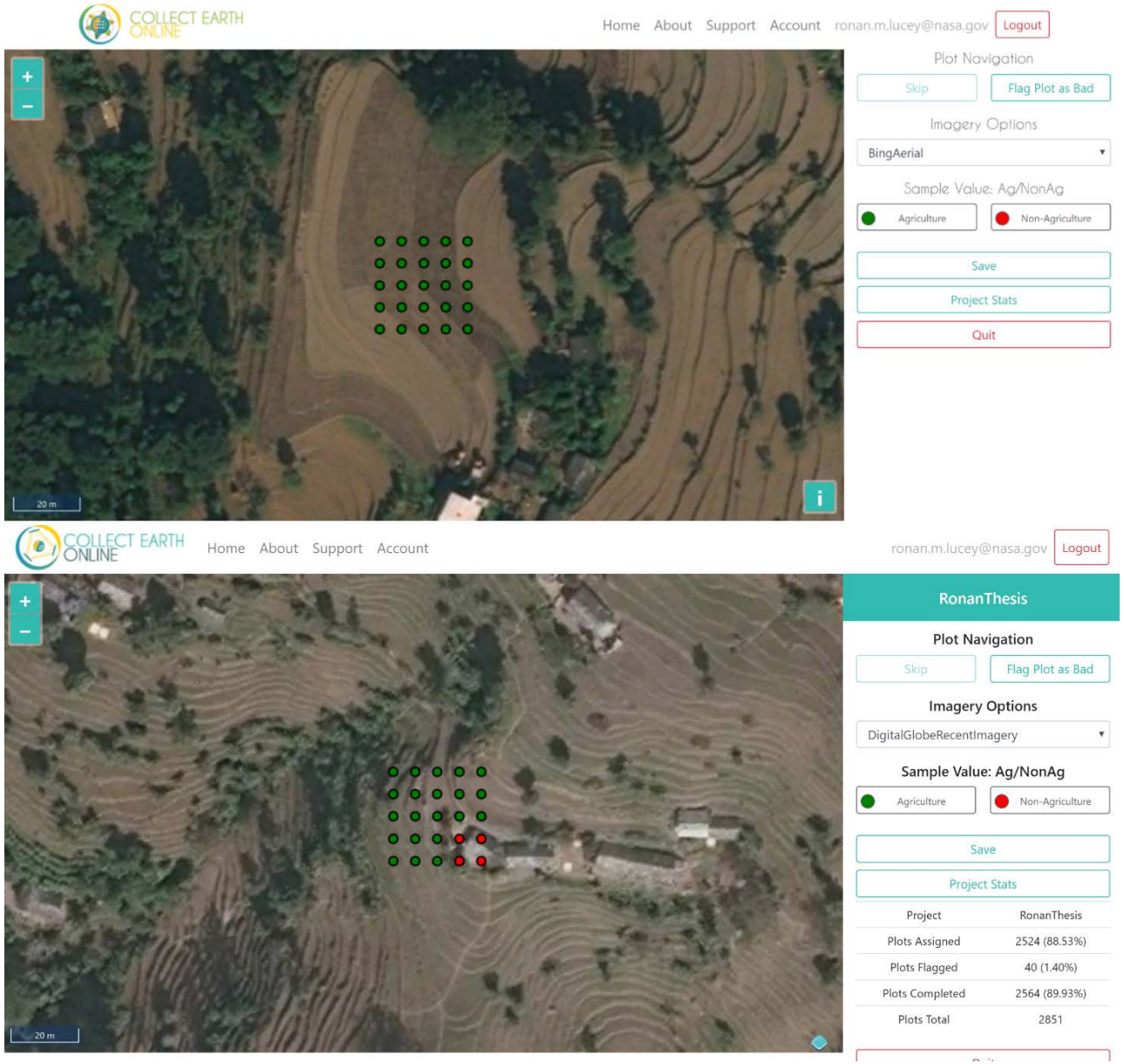
python™

Google Earth Engine

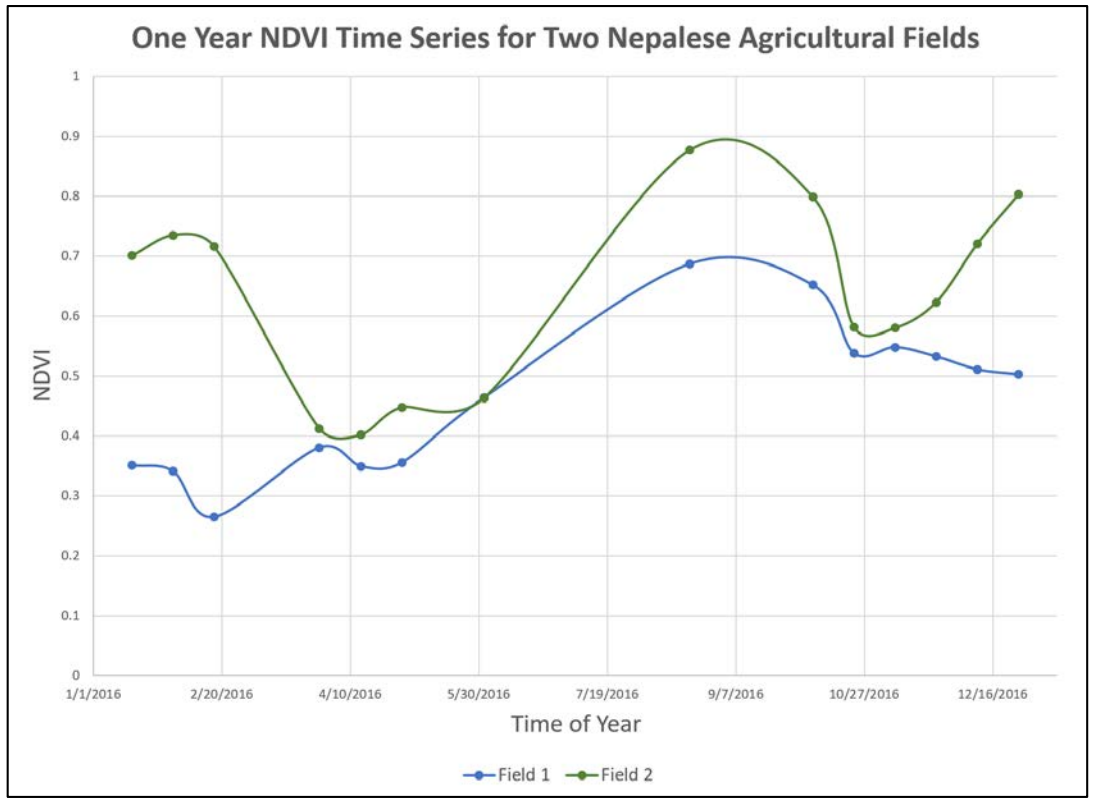
Data Accuracy Assessment

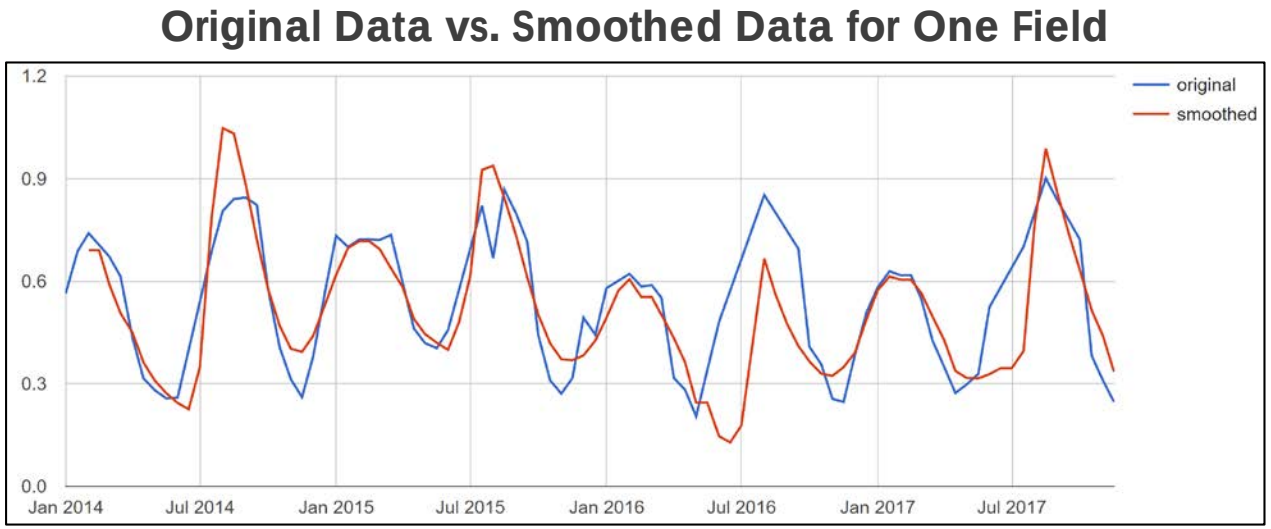
- Collect Earth Online was used for accuracy assessment of World Bank field dataset, 30 meter grid around the centroid of each field to simulate Landsat scale

- Overall, 67% of the plots (~1900) were classified as 100% agricultural cover. These fields are the ones that will be used for the analysis



Smoothing and De-spiking Data



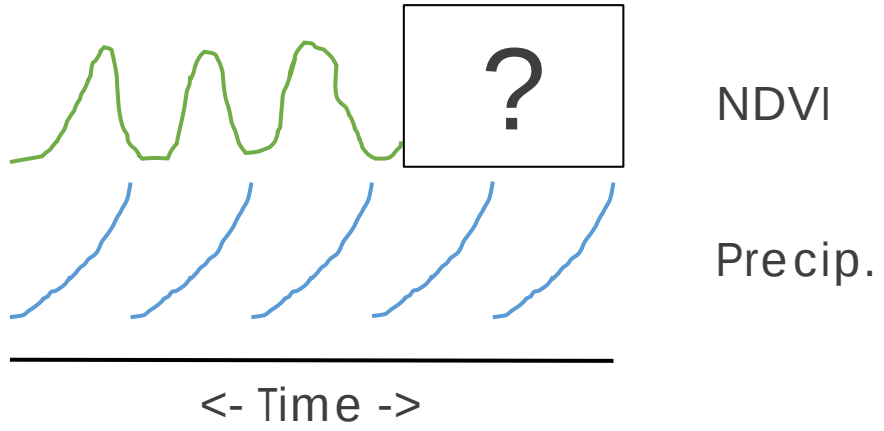


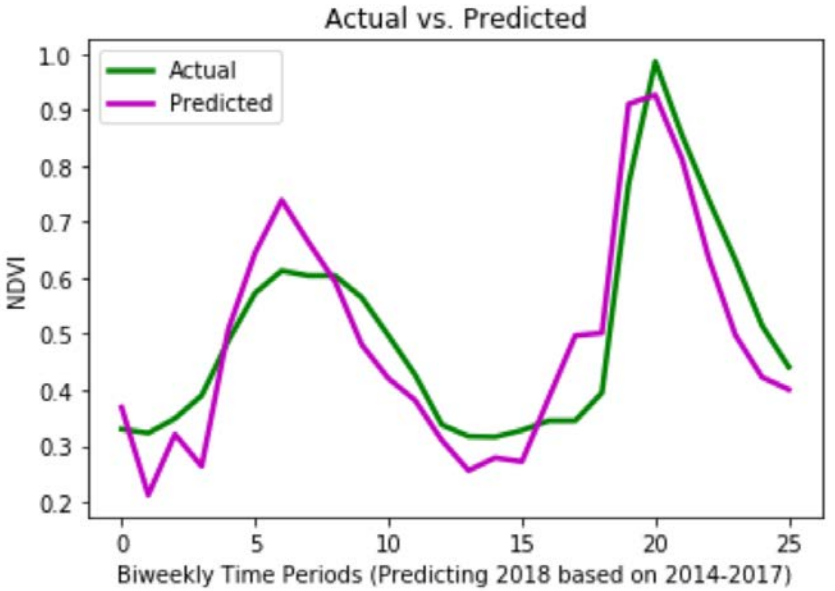
Methodology citation: FEWSNET

- Not all the same crop or same phenology cycle represented in this dataset
- The fields must be separated into clusters based on phenology. Each cluster can then be used as input to its own model
- First, data must be de-spiked and smoothed for optimal clustering

Machine Learning Approach

- The machine learning approach will aim to **back-predict NDVI** using historical time series NDVI and time series cumulative annual precipitation data
- Machine learning approaches to be explored include convolutional neural networks, recursive neural networks
- Because we know what the observed NDVI values are, we can compare the predictions from the machine learning approach to the observed NDVI values
- The overall relationship between the predicted NDVI and actual NDVI can then be determined using statistical methods





Summary

- Research Question: Can machine learning improve on existing methods for predicting NDVI, used to detect changes in productivity as a way to assess intervention impact?
- This will be accomplished by comparing results of a machine learning approach with the results of an analysis done using traditional methodology on the same dataset. **We expect that using machine learning techniques will improve on traditional techniques**
- The results of this research will potentially be an improved method for assessing agricultural interventions, which is a pressing need in the Hindu-Kush Himalaya region
- It is important to note that the point of this research is **not** to suggest to World Bank and regional organizations whether to continue treatments or not

References

Image Citations

Stanford University, Nabin Baral, International Centre for Integrated Mountain Development (ICIMOD)

Data & Methodology Citations

Landsat, Climate Hazards Group InfraRed Precipitation with Station (CHIRPS), Planet Labs, Digital Globe, Famine Early Systems Warning Network (FEWSNET), Synthetic Counterfactual Variables and Impact Assessment (SEIRS)

Major Literature Citations

World Bank Development Impact Evaluation Group (DIME), Food and Agricultural Program of the United Nations (FAO), World Food Programme (WFP). Full list of references available upon request.

Thank you. Questions?

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