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VALIDATING THE EFFECTIVENESS OF TREATMENT ON THE PRODUCTIVITY OF AGRICULTURAL FIELDS IN NEPAL USING MACHINE LEARNING TECHNIQUES AND SPACE-BORNE DATA

Abstract

Food security is a major issue in Nepal in the face of a changing climate. NASA SERVIR is a venture connecting space to village, using space-based assets and tools to help improve environmental decision-making in developing countries. Collaborating with the United States Agency for International Development (USAID), the International Center for Integrated Mountain Development (ICIMOD), and the World Bank, we assess three types of treatments done by the World Bank and the Nepal Ministry of Agriculture on selected agricultural fields – early treatment (2014-2016), delayed treatment (after 2016), and a control group that was not treated. Our goal is to detect positive or negative change in yield as a result of treatments in Nepal through the use of space-based assets, and give non-space stakeholders in Nepal the ability to make more informed decisions related to food security. To conduct this analysis, we use open source programming techniques as well as free and publicly available space-borne datasets. We use the Python programming language through a machine learning based approach. Landsat imagery will be used as an input, and potentially Sentinel imagery and MODIS/VIIRS imagery for gap filling. Climate Hazards Group Infrared Precipitation with Station (CHIRPS), a satellite derived precipitation product, also serves as an input to the machine learning algorithm. We integrate these space-borne datasets into the machine learning algorithm, using 1980-2016 data to predict 2017 yield. Yield is predicted for locations where we have ground truth data. We then compare these predicted yields from the machine learning approach for 2017 to the observed ground truth yields for 2017. Evaluating on a field by field basis, a statistically significant difference between the predicted yield and the observed yield indicates that the treatment affected productivity. By detecting positive change in yield through a machine learning based approach, we can support the expansion of World Bank and Nepal Ministry of Agriculture treatments to help combat the issue of food security in Nepal. Finding a negative change in yield can prompt changes in the treatments made and the suspension of treatments that are not having their intended effect. This is an innovative, low-cost approach that allows non-space stakeholders in Nepal to make more informed decisions related to food security through the use of space-borne assets from NASA and elsewhere. This effort has the potential to be scaled up and applied globally, complementing the existing monitoring and evaluation efforts of USAID.