Crop Damage Detection

Project Goal

Traditional scouting methods were always used by corn farmers in determining the extend of crop damages in case of extreme weather events. These kinds of methods are tedious and difficult to ascertain the extent of the damage. ArcGIS, Machine Learning and drone mapping provides a faster, efficient and accurate way to evaluate these damages.

The objectives of this project include: Examining the cornfield and identifying damaged corn areas, estimating the area of the unused cornfield and approximating the average corn height and plant density.

Provided Data

The geodata of the cornfield of approximately 9.43 hectare was acquired using a drone. The data obtained was in form of point cloud (of about 5.5 million points) and the images. The data is registered similarly to a basemap with WGS 1984 Web Mercator projection reference system and vertical units in meter, hence creating a georeferenced integrated spatial dataset.

Applied Methods

Preprocessing

The acquired geodata was comprised of multiple 4-band images and point cloud – LAS (with same geographic relation) datasets. The images were then mosaiced to form an orthomosaic raster image. Prior to the data analysis, radiometric corrections were done to correct for the measured brightness value of pixels, band to band error, and geometric and panoramic distortions that occurred during the acquisition process.

Data Analysis

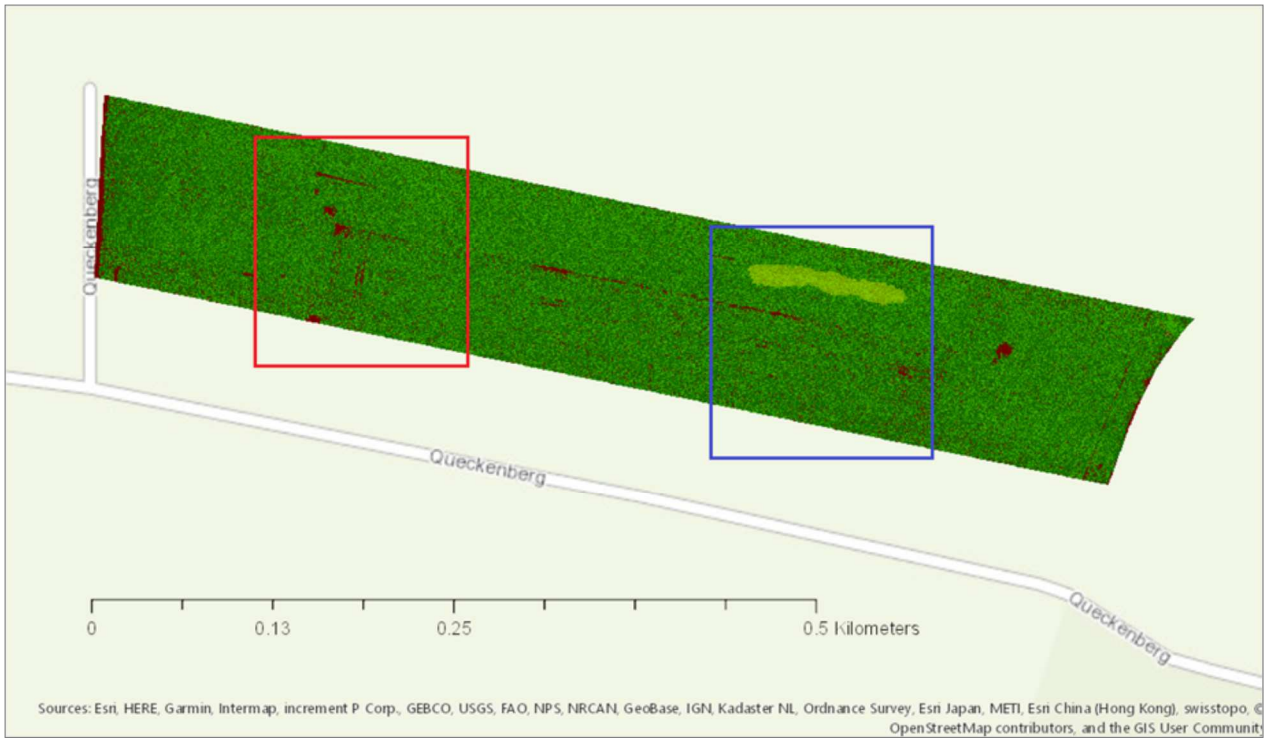
To enable for photointerpretation, the orthomosaic raster image was processed to ensure the pixels characteristics are enhanced and susceptible to this interpretation. To allow for identification of different features on the digital image, an image classification algorithm was done. In this algorithm the pixels form groups in multispectral space that corresponded to the different information classes and spectral classes. Both the supervised and unsupervised classification were performed on the orthomosaic image, hence identifying damaged corn areas and estimating the unused areas on the field. This was done through collection of training samples, training the samples and using these samples in the classification of the orthomosaic image in relation to each pixel's spectral feature.

The LAS dataset was used to generate geospatial products from the raster image e.g. extraction of the Digital Elevation Model (DEM) and Digital Surface Model (DSM). These are variables needed for band arithmetic in deriving corn heights.

For estimation of corn growth stage, precision and accuracy in photointerpretation of the cornfield, an estimation of the NDVI (Normalized Difference Vegetation Index) was also done on the raster images.

Project Outcome

By applying the image classification algorithm, an approximate of 5.51% of the 9.43 hectares of the cornfield area was identified as bare soils. While around 0.69% (i.e. 0.065 ha) was detected to be the part of the cornfield where the corn was damaged. The recommended amount of plants to be planted for the total area of the cornfield was 279,128, but only 261,823 plants were counted. This makes a total difference of 17,304 plants between the counted and the planned amount of plants.

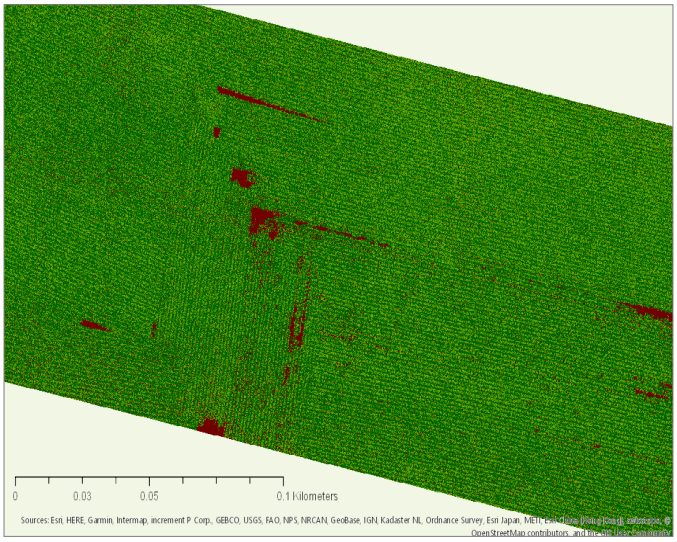


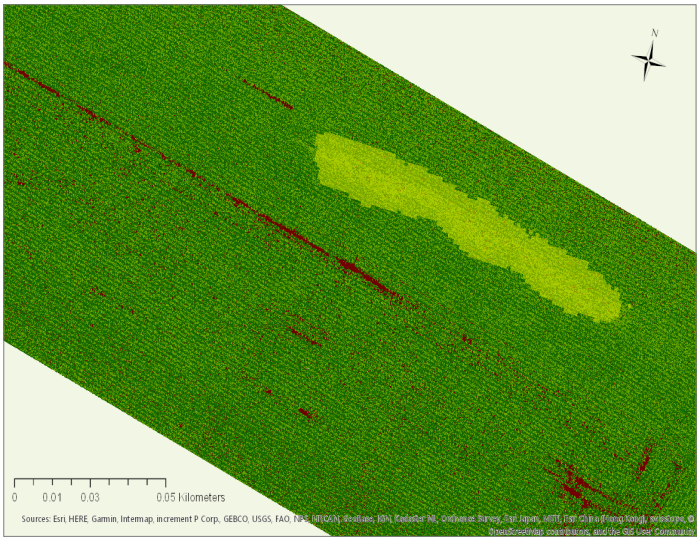
Legend

To be zoomed for bare soils

To be zoomed for damage area

At the time the data was obtained, the corn was at its reproductive growth stage, this was estimated to be between R3 and R5 i.e. between milk and dent (this means the kernel was yellow outside, milky white fluid inside, and most kernels at least partially dented respectively). Using raster calculation on the DSM and DEM, an average corn height of 2.1 meters was derived. The average plant density was estimated at 29,600 plants per hectare.





Legend

Bare soils

Corn

Damaged corn