CASE STADY. IRAN: AGRICULTURAL AREAS DETECTION AND CROP DEVELOPMENT

The satellite sensors have a special kind of the camera on the board, which captures the images in different spatial resolutions and spectral bands. In general, cameras capture imageries in the following electromagnetic ranges: visual range (i.e. Red, Green, Blue), near Infra-Red range (i.e. NIR), wide Visual range (i.e. panchromatic or pan). The spectral bands separately and in a various combinations are used to make different thematic analysis.

The most known application of the multispectral satellite imagery is **LandUse Mapping**. LandUse can be created by means of the Machine Learning (ML) and Artificial Intelligence (AI) techniques. For those approaches, well-known workflow exists: gathering the data for the training set (vector points with definitely known identity according to LandUse); designing and training of computer model for satellite imagery stacks; validation of already trained models; classification (i.e. recognition) of all elements of the earth surface which are presented in the satellite imagery.

Agricultural areas detection. Iran

For this study the most valuable bands are NIR and Red. There is a well-known rule: **Lush vegetation with a lot of the biomass has high values in NIR band and low - in Red band. Poor sparse vegetation is vice versa.**

The Figure 1 illustrates the rule. The Image is visualized with using a False Color scheme (i.e. "Red Image"). Near Infra-Red (NIR) band has a leading role in this scheme. As result, the vegetation has a red variation of the color. The more reddish the object is, the larger biomass it has.

Normalized Difference Vegetation Index (NDVI) was designed for unification of the biomass related analyses. In spite of many others indexes, NDVI has a crucial role in any vegetation research. It can be calculated as it is shown below:

$$NDVI = \frac{(NIR - Red)}{(NIR + Red)}$$

This index is directly correlated with biomass. It helps to classify a territory by quantity of the vegetation in certain moment of the time.

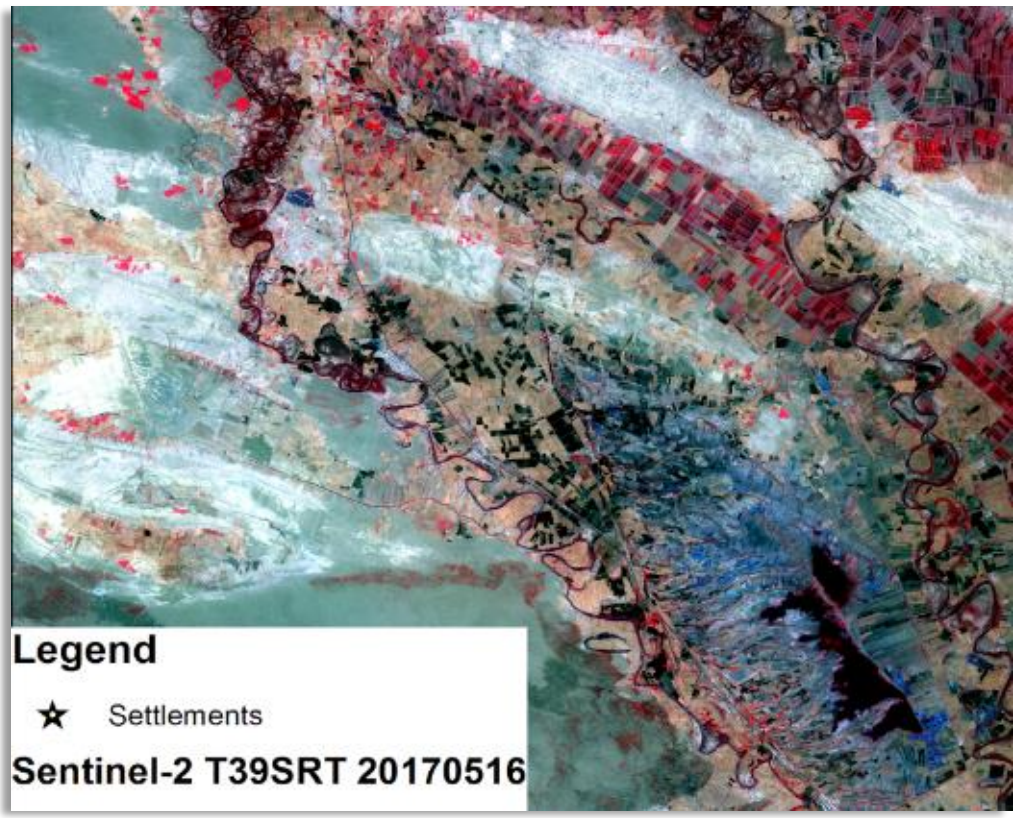
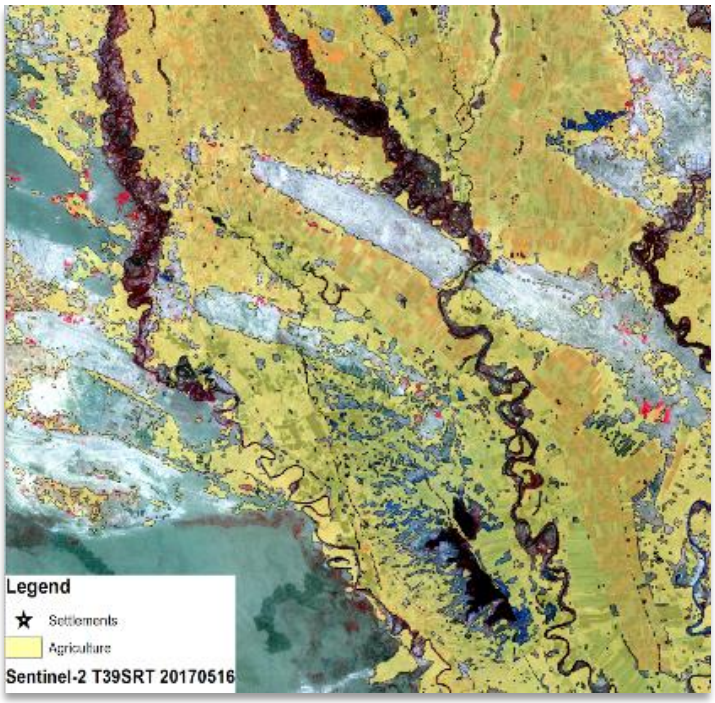


Figure 1. Sentinel 2 image in False Color scheme

The agriculture regions can be localized based on the NDVI index changing during the year or several years

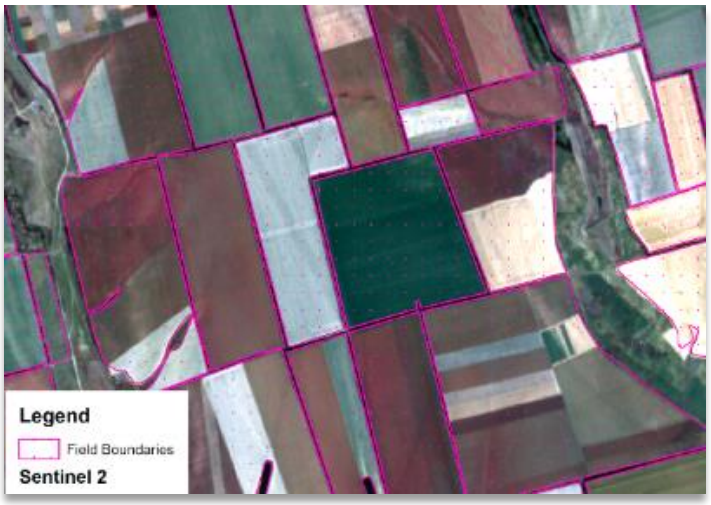
For this purpose, Phenological NDVI Metrics was used. In fact, the metric is a plot displaying NDVI vs Time and it describes biomass changing. Crops have special metric pattern with a periodic structure, evergreen and leaf forests have other patterns. Bare territories and water bodies have extremely low NDVI values.



Agriculture region recognized by means of NDVI metric

Delineation of the Field Boundaries

Delineation of the field boundaries is a task of the identification of vector edges around the fields. It is a part of the computer vision science, or rather, image segmentation consisting of edges detection, texture calculation and prediction of the object shape



Delineation of the Field Boundaries

Crop Identification

Next level of the agriculture analyses is a Crop Identification within previously detected field boundaries (Figure 5). Accurate identification needs a series of imageries since each crop has specific phenology behavior. The plants need the appropriate temperature and wetness for planting. They have a various seedlings and harvest time. This information can serve as a set of markers that can help recognize the kind of the crop. Furthermore, based on the series of the satellite images and the aforementioned algorithms of Machine Learning the following characteristics can be recognized: estimation of the soil wetness, seedless areas, crop health, harvest stage, damaged crop, etc (Figure 2 & 3).