ISSN 2181-9408

Scientific and technical journal

Sustainable Agriculture

№4(8).2020

Founder: Tashkent Institute of Irrigation and Agricultural Mechanization Engineers
Our address: 39, Kari-Niyaziy str., Tashkent 100000 Uzbekistan , www. sa.tiiame.uz

The journal "Sustainable Agriculture" is registered in the Press Agency of Uzbekistan on the 12th of February in 2018 (license № 0957).

In 2019, the journal is included in the list of recommended scientific publications by the Higher Attestation Commission of the Republic of Uzbekistan.

USING REMOTE SENSING FOR CREATING FERTILIZER SPEADING MAP ON PRECISION AGRICULCUTE

I.M. Aslanov, A.N. Jumanov
Tashkent Institute of Irrigation and Agricultural Mechanization Engineers

Abstract

Precision farming requires detailed information about the field and the plots within it. Key information about the diversity of farmland characteristics is collected by taking and analyzing soil samples to determine the optimal amounts of used seed, fertilizer and other substances, which can increase yields, reduce unproductive costs, and thereby achieve greater return on investment. From year to year, using spatial information and analyzing a constantly updated knowledge base, the manufacturer consistently improves the results of his enterprise. Such technologies and solutions based on them of different levels and scales are suitable for all farms, and with a fully functional corporate-wide implementation, they are especially promising in large agricultural holdings with large the size of the fields and the high variability of the species composition of soils, their structure and fertility, susceptibility to damage to crops by diseases and pests. Geographic information systems serve as an essential integration component of precision farming solutions.

Key words: Remote Sensing, Yield mapping, Fertilizer, Precision Agriculture; agricultural land; ArcGIS;

Introduction. Geographical information system (GIS) technologies has great potentials in the field of agriculture and has opened newer possibilities of improving agriculture land mapping system as it offers accelerated, repetitive, spatial and temporal synoptic view. One of the modern trends in agricultural production and agribusiness is the concept of the so-called precision farming. It represents and develops a unified process for managing the growth and productivity of crops in accordance with their needs and taking into account the detailed intra-field variability of the plant habitat. This technology became possible thanks to the development of informatics, communication systems, progress in the field of automation of agricultural machinery and equipment, the development of special sensors and measuring complexes for collecting information in the field. [3], understanding how ecosystem work [6] and assessing the effects of future land use change on nutrients [9].

The task that any specialist working with data on land plots faces is to verify and ensure their accuracy. Information may: come from different sources, from several contractors; plotted on an electronic map based on the results of geodetic surveys, digitization of aerial photographs and satellite images, scanned plans; Receive in real time or recreate based on archived data. With any of these options, and especially when used together, errors can occur, such as intersecting fields, mismatched borders, typos in the name of the crop, or simply unfilled characteristics of the objects. Remote Sensing allows you to correct the errors found, as well as ensure high quality data with the subsequent introduction of additional information.[3]

Precision farming is an integrated high-tech agricultural management system that includes technologies for global positioning GIS technology for remote sensing of the Earth (ERS), technologies for assessing yields (Yield Monitor Technologies), technology for variable rate setting (Variable Rate Technology), and technology for geographic information systems (GIS) is an integrating basis for the accumulation, storage, processing, modeling, interpretation, analysis and display of all collected information characterizing crops, arable land and environmental factors, the entire agricultural landscape.[5]

Background of this study. Recommendations for variable dosage of fertilizers. They aim to change soil composition and are based on a variety of factors, including current soil nutrient levels, yield target, crop type and yields in the past and prior years. Often such guidelines are made for each operating area. Since the above data is known for each point in the field, the farmer can accurately calculate the required amount of applied substances at each point. Applying the exact dosage at each point, the farmer not only cares about the health of the crop, but also reduces his costs for agrochemicals and other material resources.[1]

Harvest with test plots. Variable dosage recommendations are based on exact formulas and may take into account additional factors such as climatic zone, meso- and microclimatic conditions, product and soil type. To achieve additional increases in yield, the grower may deliberately apply more or less of the substance in certain areas of the field in order to test the correct application rates of nutrients. The locations of these test plots must be accurately mapped and documented so that yields can be compared at the same points.

Methods. The normalized difference vegetation index (NDVI) is one of the most widely used vegetation indexes and its utility in satellite assessment and monitoring of global vegetation cover has been well demonstrated over the past two decades. [7] It is defined as

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

where NIR and RED represent surface reflectances averaged over visible $(\lambda \sim 0.6\ \mu m)$ and near infrared (NIR) $(\lambda \sim 0.8\ \mu m)$ regions of the spectrum, respectively. The NDVI is correlated with certain biophysical properties of the vegetation canopy, such as leafarea index (LAI), fractional vegetation cover, vegetation condition, and biomass. NDVI increases near-linearly with increasing LAI and then enters an asymptotic phase in which NDVI increases very slowly with increasing LAI.

Data collection. To evaluate (locate) the current situation in the field in the best possible way, the field was recorded during visit to the main local farms and their owners. Shorter surveys can be carried out in the process with farm owners. In addition to obtaining important technical data, this also provides an insight into the main issues in production. Also, each farm owner is required to submit a map showing the current situation and the location. These mostly include sketches or old plans that were either copied by hand or photocopied and thus diminished from the original cadastral maps. Maps very often include a legend on the field boundaries showing the types of crops grown, and each field has its own identification number. Preparation of the thematic GIS layers in the process of preparing GIS layers, several raster resolutions are used:

(1) Basic resolution for calculation of suitability, 100 m;
(2) LANDSAT image at 30 and 15m resolution;
(3) A detailed topographic map 1:100 K, also at 15 m resolution.

Boundaries of the area are set to Xmin = 6490027; Ymin = 5005476; Xmax = 6587527; Ymax = 5088076 (Gauss-Krueger system, zone 6), which means that the total area is 97 × 83km. Panchromatic image is at 15 m resolution (5508 × 6501 pixels). According to this methodology, the following thematic layers are made. The methodology of preparing thematic layers follows. For raster data we can use open source from internet source www.remotepixel.ca, for NDVI analyze we need download two raster images red (B4) and near infrared (B5).

Results. Various vegetation indices are often used in precision farming, and the NDVI is the most popular one. It allows you to monitor fields and crops at any point of the globe using satellite images. Here is a simple explanation of what the NDVI vegetation index is and how to use it for field analysis. It is important to understand that the NDVI is an indicator of the plant's health but it says nothing about the cause of a particular condition. The vegetation index is rather a hint at what is currently happening on the field. Let's consider three scenarios of NDVI usage for field analysis: at the beginning, in the middle, and at end of the growing season. At the beginning of the season, the NDVI index helps to understand how the plant has survived through the winter. If the NDVI is lower than 0.15, most probably all the plants died in this part of the field. Typically, these figures correspond to plowed soil without any vegetation. 0.15–0.2 is also a low value. This may indicate that plants started wintering in the early phenological phase, before tillering. 0.2–0.3 is a relatively good value. Probably, the plants entered the tillering stage and have resumed vegetation. 0.3–0.5 is a good value.

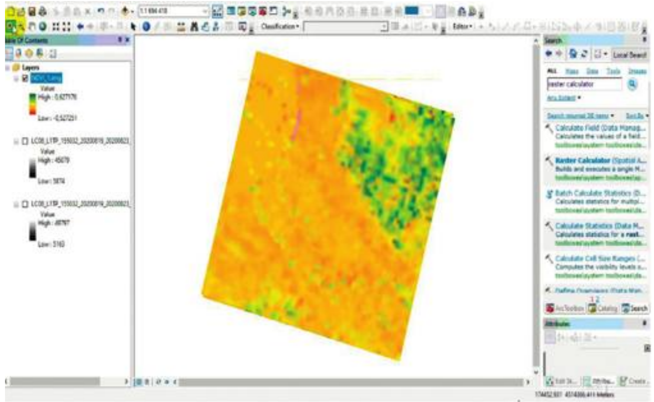

Figure 1. NDVI analyzing by ArcGIS

Figure 2. Fertilizer Speading map

Nevertheless, you should keep in mind that high NDVI values can indicate that plants wintered at a late phenological stage. If the satellite image was taken before the resuming of vegetation, then it is necessary to analyze the zone after the resuming of the vegetation also. Above 0.5 is an abnormal value for the post-wintering period. It is better to check this field zone yourself. To sum up, if you see abnormal NDVI values (those that are very different from the average values for the field), you need to check this field area. You can see the NDVI index for your fields, monitor when the weather is cloudless, images are updated every 3–5 days.

In results we get the maps identified in the traditional way and using NDVI analysis. In the traditional method, an equal amount of fertilizer is applied to all contours. Using a map identified and created using NDVI analysis, the exact coordinate fertilizer is applied and the crop is fertilized with as much fertilizer as needed. This increases economic efficiency and increases soil fertility as well.

Conclusion. The use of remote sensing in agriculture can be used to monitor agricultural areas, create agricultural maps. Based on the results, agricultural reclamation will not only increase economic efficiency, but also help to preserve and increase soil fertility.

References:

1. Abbas A. and Khan S., "Using remote sensing techniques for appraisal of irrigated soil salinity," in Proceedings of the
2. Abo-Shetaia, A.M., Ashoub, M.A., Ismail, M., Al-Khaled, E.A., 2005a. Estimation of some summer crops area and yield prediction using remote sensing techniques. Ann. Agric. Sci. 50, 481–498.
3. Clay D.E., Shanahan J.F. 2011 GIS Applications in Agriculture. CRC Press 462p.
4. Dehni A. and Lounis M., "Remote sensing techniques for salt affected soil mapping: application to the Oran Region of Algeria," Procedia Engineering, vol. 33, pp. 188–198, 2012.
5. International Congress on Modelling and Simulation (MODSIM '07), L. Oxley and D. Kulasiri, Eds., pp. 2632–2638, Modelling and Simulation Society of Australia and New Zealand, Brighton, UK, December 2007
6. Runquist, S., Zhang, N., Taylor, R.K., 2001. Development of a field-level geographic information system. Comput. Electron Agric. 31, 201–209.