Chapter 9
Determination of Soil Color Characteristics Using RGB Images

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ABSTRACT

The purpose of the research is to identify color patterns of different types of soils to assess the conditions for identifying types using RGB images. To achieve this goal, the following tasks were solved: 1) Identify problems in the agricultural plan where soil plays an important aspect; 2) identify the characteristics of the soil composition and the relationship between the composition and color characteristics; 3) determine the features of processing RGB images during preliminary and thematic processing; 4) evaluate the color characteristics of several types of soils; and 5) determine criteria for distinguishing the color characteristics of different types of soils. The object of research is the soil type and its RGB images. Research methods included the collection of statistical information about brightness variations in RGB spectral channels for different types of soils.

INTRODUCTION

Currently, for many countries there is a problem of food independence and security due to the negative economic background, the emergence of low quality natural and synthetic food products, which is a consequence of deteriorating public health. Soil is an important asset of any country, given its use to ensure

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food independence and obtain high-quality food products, which determines the relevance of soil research (Zhukova, 2021, Godin, 2020, Androkhanov, 2004, FAO, 2006, McBratney, 2003, Dobrovolsky, 2015).

The emergence of a technological base for work in agricultural areas makes it possible to intensify agricultural production, and this, on the other hand, requires the development and implementation of highly effective soil research methods. When studying soils, it is necessary to achieve high efficiency and accurate, objective information about the state and properties of the territory under study and the soils located on it. Since agricultural areas are usually large in size, it is preferable to solve the problem of soil research using remote sensing methods. Remote sensing research approaches include satellite approaches (Lagacherie, 2007), aircraft (Andronikov, 1979) and unmanned approaches (Colomina, 2014).

One of the most common methods for studying the surface of the earth and soil in particular is the optical spectrometric method, which allows one to obtain quantitative characteristics of individual soil properties. The studies of the spectral reflectivity of soils, which is the basis of the spectrometric method, are the subject of the works of many authors (Orlov, 2002, Kostenko 2009, Bowers, 1965, Karavanova, 2003, Viscarra, 2016). These studies show that the formation of soil reflectivity is influenced by several factors, which can be divided into two groups - physical and chemical. The physical group includes the ratio of soil areas with different colors, structural state (texture, lumpiness), humidity, etc., and the chemical group of factors includes the content of carbonates, iron compounds, salts, mineral and granulometric composition, humus content, etc. (Aparin, 2016, Shishov, 2004). The basis of the spectrometric method is that the optical indicators of soils and their components are related to the material composition of the organic and mineral parts of soils and are indicative parameters for identifying the type of soil.

Conducting a comprehensive study of the optical properties of soils is most relevant for regions where agriculture is an important industry and, therefore, the load on the soil is increased. It is known that the use of soils in agricultural production is accompanied by intensified processes of degradation of soil quality (Dobrovolsky, 2002). Therefore, the use of simple approaches that will allow agricultural workers to control soil characteristics is important and highly relevant. In this regard, the goal of the work is related to identifying the features of optical parameters expressed in color for different types of soils and the possibility of constructing a bank of soil color indicators to determine trends in indicators.

The high level of agricultural land use for various crops causes intensive soil cultivation, which causes the gradual destruction of the soil structure. Changes in the structure of the soil lead to a deterioration in its water, air, thermal and nutrient regimes, as well as increased erosion. Therefore, regular and systematic study of soil resistance to technogenic (agricultural) impacts is the basis for assessing the degree of soil degradation throughout the entire territory of the agricultural field being studied. Such studies make it possible to establish an acceptable limit for the impact load on the soil, allowing for compliance with the time frame for intensive land use and guaranteeing the preservation of soil functions.

Research of the entire surface of agricultural fields, as a whole, will allow us to implement an approach leading to the following effects: 1) economic (reducing the cost of growing crops for all processes existing for this); 2) environmental (increasing the content and improving the balance of organic matter, preserving moisture, reducing CO2 losses from the soil, maintaining soil structure, reducing the threat of erosion); 3) organizational (reducing the number of technological operations when growing crops).

Currently, there are approaches that make it possible to obtain promptly objective data on the agrochemical characteristics of agricultural lands. Such approaches include satellite remote sensing (ERS) (Kataev, 2017) and the use of unmanned aerial vehicles (UAVs) (Kataev, 2021). Among satellite remote sensing devices, one can distinguish optical and radar ones, which allow obtaining images with varying regularity (from a day to two weeks). However, optical satellite instruments are significantly hindered