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ANALYSIS OF THE NDVI INDEX ON THE EXAMPLE OF THE PEREHINSK TERRITORIAL COMMUNITY

Remote sensing, the process of collecting data from a distance, has revolutionized our ability to monitor and understand the Earth's surface. Among the plethora of indices and metrics used in remote sensing, the Normalized Difference Vegetation Index (NDVI) stands out as a powerful tool for assessing vegetation health and dynamics. Developed in the 1970s, NDVI has since become a cornerstone in environmental monitoring, agricultural management, and land cover analysis [1].

At its core, NDVI quantifies the density and health of vegetation by leveraging the reflectance properties of two key wavelengths: near-infrared (NIR) and red light. The formula for NDVI is straightforward (1):

$$NDVI= (NIR+Red)/(NIR-Red), \qquad (1)$$

where NIR is the reflectance in the near-infrared spectrum and Red is the reflectance in the red spectrum. The resulting values range from -1 to 1, with higher values indicating denser and healthier vegetation. Negative values typically represent water bodies or clouds, while values close to zero suggest barren land or urban areas with little to no vegetation.

The strength of NDVI lies in its sensitivity to chlorophyll content and canopy structure. Healthy vegetation absorbs most of the visible red light for photosynthesis, while reflecting a significant portion of NIR light. Consequently, the NDVI values for healthy vegetation are relatively high due to the large NIR reflectance and low red reflectance. Conversely, stressed or sparse vegetation exhibits lower NDVI values, as seen in areas affected by drought, disease, or human activity.

One of the key advantages of NDVI is its applicability across various spatial and temporal scales. It can be computed from multispectral satellite imagery, aerial photography, or ground-based sensors, offering insights into vegetation dynamics at local, regional, and global levels. Additionally, NDVI facilitates the monitoring of seasonal changes, phenological shifts, and long-term trends in vegetation cover, providing invaluable information for land management, biodiversity conservation, and climate change research.

In agricultural contexts, NDVI is widely used to optimize crop production, monitor crop health, and assess the effectiveness of irrigation and fertilizer applications. By mapping NDVI spatial patterns within fields, farmers can identify areas of concern, implement targeted interventions, and maximize yields while minimizing inputs. Similarly, conservationists leverage NDVI to evaluate habitat quality, track deforestation, and prioritize areas for restoration efforts.

One of the main tasks of ensuring a high-quality information approach to the development of ATCs based on the content of the administrative reform is the development of regional GIS [2], which is the main objective of this study. The territory of the Perehinsk community lies within the Limnytsia River basin, which is one of the cleanest rivers not only in Ukraine but also in Europe. It is well known that the formation of the river's water balance often depends on the condition and quality of the vegetation cover. An equally important factor in shaping the structure of the territory's forest plantations is its altitude gradation from the Carpathian Mountains to the pre-Carpathian trough, which characterises the region as a zone of coniferous forests in the highlands and mixed forests in the Limnytsia River valley. The region's main industry is timber processing, so the study of the vegetation index is important not only for modelling and analysing economic benefits and risks, but also for studying the impact of global climate change and unauthorised logging on the ecosystem as a whole.

Google Earth Engine is a powerful tool for analysing geospatial data. It provides access to a large number of satellite images and other geospatial data, and has integrated tools for processing, analysing and visualising them.

Downloading a large number of satellite images and organising them for research takes time and a large amount of storage space. When using Google Earth Engine, there is no need to download satellite imagery, which is an advantage.

The Sentinel-2 satellite images with cloud cover not exceeding 10% were used in the script (Fig.1).

The data show a significant difference in biomass production between 2018 and 2023 (Table 1). The NDVI index in 2018 is higher due to more favourable conditions for vegetation development. Humidity at that time was quite high, precipitation was frequent and floods were not uncommon. The situation in 2023, as can be seen from the data obtained, was radically different - it was a dry period accompanied by extreme heat, precipitation was not as frequent as in 2018. The ability of tree leaves to photosynthesize decreases when their temperature becomes too high. Due to the abnormal heat, some of the leaves may have crossed a critical temperature threshold after which their ability to photosynthesize is impaired.

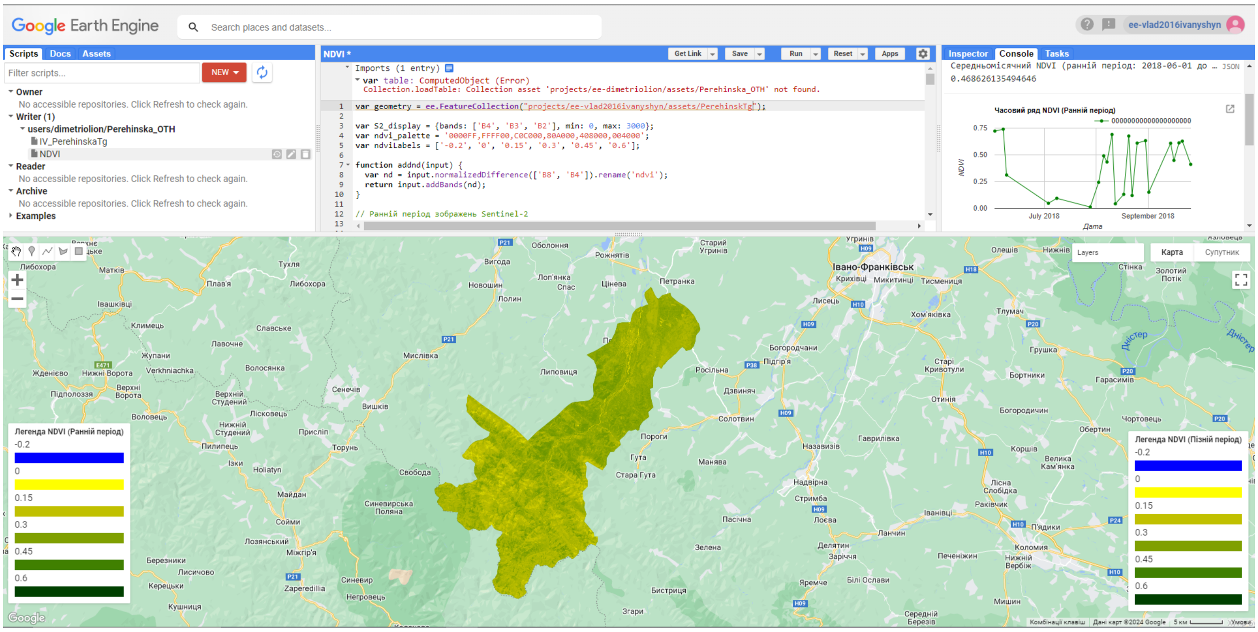

Fig. 1. NDVI index of Perehinsk territorial community

Analysing the results, it is difficult to assess which areas were most affected by this or that factor. Therefore, an additional difference model was built. The average difference value for the study area is -0.229. This is a fairly large figure. And as can be seen from the model, it is the mountainous areas that have undergone the greatest changes, which directly indicates significant deforestation in the study area.

Table 1. Average values of the NDVI index

Month	2018	2023
June	0,591	0,337
July	0,051	0,387
August	0,407	0,284
September	0,477	0,314
Average	0,464	0,330

Conclusion. The Perehinsk territorial community is a typical example that characterises the mountainous and foothill vegetation structure, which is important for sustainable development of the territory. 2 The vegetation index of a territory is dependent not only on forestry activities, but, as can be seen from the results of the study, is also dependent on the factor of global temperature changes in the water balance of the territory. The satellite image interpretation data allowed us to summarise the dynamics of the vegetation index change for two similar periods, in particular, for 2018 it is 0.464, for 2023 - 0.330. The interpretation of the results of this study can serve only as one of the initial stages for studying the index, taking into account all possible factors that may occur.

References

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