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ASSESSMENT OF THE ECOLOGICAL RECLAMATION STATUS OF SOILS USING VEGETATION INDICES

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Abstract
This article aims to highlight the practical importance of assessing the land reclamation status through geographic information systems, as well as monitoring vegetation cover in regions using vegetation indices.

Keywords: Esri, GIS, NDVI, soil monitoring, vegetation indices.

Introduction

Today, attention to irrigated areas in the world is increasing every year. The reason is that according to FAO data, the world's cropland continues to decrease year by year. The annual land cover images were published in the Global Assessment of Environmental Change (SOLAW) report. According to this data, the land greenness index is decreasing year by year. This indicates that the scale of forest fires is increasing, the ecological situation is deteriorating, the scale of cropland is decreasing, and as a result, the plant world is decreasing.

Bugungi kunda dunyo bo‘yicha sug‘oriladigan maydonlarga bo‘lgan e’tibor yil sayin ortib bormoqda. Sababi FAO ma’lumotlariga ko‘ra yildan yilga dunyo bo‘yicha ekin maydonlarining qisqarishi davom etmoqda. Atrof-muhitni o‘zgarishini baholash global ma’lumotlari (SOLAW) hisobotida yer qoplamlarining yillik rasmlari e’lon qilingan. Bu ma’lumotlarga ko‘ra yerlarning yashillik indeksi yildan yilga pasayib bormoqda. Bu o‘rmon yong‘inlarning ko‘lami oshib, ekologik vaziyatning yomonlashib borayotganligini, ekin maydonlarining ko‘lami qisqarib borayotganligini, natijada o‘simliklar dunyosining kamayishiga olib kyelayotganligini ifodalaydi.

ESRI is a global leader in geographic information systems (GIS), location intelligence, and mapping software. Since 1969, the software has been analyzing changes around the world through geographic science and geospatial analysis.

ESRI geografik axborot tizimlari (GIS), joylashuv razvedkasi va xaritalash dasturlari bo‘yicha jahon yetakchisi hisoblanadi. 1969 yildan beri bu programma geografiya fanlari va geofazoviy tahlillar bilan dunyo bo‘yicha o‘zgarishlarni taxlil qilib kelmoqda.

Our biggest challenges, including climate change, sustainability, and social and economic inequality, are interconnected and inextricably linked to geography. A scientifically grounded geographic approach can help us understand these interconnected issues holistically, bringing

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together all types of data.

Bizning eng katta muammolarimiz, jumladan iqlim o‘zgarishi, barqarorlik va ijtimoiy va iqtisodiy tengsizlik geografiya bilan o‘zaro bog‘liq va uzviy bog‘liqdir. Ilmiy asoslangan geografik yondashuv barcha turdagi ma’lumotlarni birlashtirgan holda ushbu o‘zaro bog‘liq masalalarni yaxlit tushunishga yordam beradi.

In the 1960s, Jack and Laura Dangermond set out to create technology that would help balance human development and environmental stewardship. Laura was a social scientist interested in rational thought and analysis. Jack was a landscape architect who learned entrepreneurship and customer service from the family business.

1960-yillarda Jek va Laura Dangermond inson taraqqiyoti va atrof-muhitni boshqarishni muvozanatlashda yordam beradigan texnologiyani yaratishga qaror qilishadi.. Laura rasional fikrlash va tahlilga qiziqqan ijtimoiy olim edi. Jek peyzaj me’mori bo‘lib, oilaviy biznesdan tadbirkorlik va mijozlarga xizmat ko‘rsatishni o‘rgangan.

While Jack was at Harvard, they both worked in the university's Computer Graphics and Spatial Analysis Laboratory, where they primarily developed mapping software. Inspired by the possibilities of the technology, they envisioned using computer mapping and analysis to solve complex problems. In 1969, they founded ESRI, then known as the Environmental Systems Research Institute (ESRI), in their hometown of Redlands, California.

Jek Garvardda bo‘lganida, ikkalasi ham universitetning kompyuter grafikasi va fazoviy tahlil laboratoriyasida ishlagan bo‘lib, u yerda asosan xaritalash dasturlari ishlab chiqarilar edi. Texnologiyaning imkoniyatlaridan ilhomlanib, ular murakkab muammolarni hal qilish uchun kompyuter xaritasi va tahlilidan foydalanishni nazarda tutdilar. 1969 yilda ular o‘zlarining tug‘ilgan shaharlari Kaliforniyaning Redlend shahrida o‘sha paytda Environmental Systems Research Institute (ESRI) nomi bilan tanilgan ESRI kompaniyasiga asos solgan.

In our research, we studied the changes taking place in the 1st Boyovut region over the past five years using the ESRI program for monitoring vegetation indices. Vegetation monitoring was studied using vegetation indices such as NDVI, EVI, GNVI, SWI, TROE COLOR. In general, vegetation indices help us to understand the vegetation indices of the region more broadly by studying their working processes.

Biz tadqiqot ishlarimizda 1-Boyovut hududida keyingi besh yil davomida bo‘layotgan o‘zgarishlarni ESRI programmasi orqali o‘simliklar monitoringini vegetatsiya indekslari orqali o‘rganib chiqdik. O‘simliklar monitoringini NDVI, EVI, GNVI, SWI, TROE COLOR kabi vegetatsiya indyekslari yordamida o‘rganildi. Umuman olganda vegetatsiya indekslari ularning ishlash jarayonlarini o‘rganish orqali biz hudud o‘simlik indekslarini kengroq tushunishimizga yordam beradi.

Vegetation index is an important indicator in analyzing plant development. Among the many advantages of vegetation indices in remote sensing, the accuracy of data and the possibility of remote monitoring are the main reasons for the transition to this user-friendly technology.

O‘simliklarning rivojlanishini tahlil qilishda vegetatsiya indeksi muhim ko‘rsatkich hisoblanadi. Masofadan zondlashda vegetatsiya indekslarining ko‘plab afzalliklaridan ma’lumotlarning aniqligi va masofadan monitoring qilish imkoniyatlari ushbu foydalanuvchilar uchun qulay texnologiyaga o‘tishning asosiy sabablari hisoblanadi.

As sensors improve, Earth observation satellites will feed remote sensing developments with new

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data that will improve existing analysis methods. With ongoing innovation in the field of vegetation index applications, companies that already have index-based software, as well as those planning to launch a new solution, can significantly increase the demand for their field monitoring applications.

Datchiklar takomillashgan sari Yerni kuzatish sun'iy yo'ldoshlari mavjud tahlil usullarini yaxshilaydigan yangi ma'lumotlar bilan masofadan zondlash ishlanmalarini oziqlantiradi. O'simliklar indeksi ilovalari sohasida davom etayotgan innovatsiyalar bilan, allaqachon indeksga asoslangan dasturiy ta'minotga ega bo'lgan kompaniyalar, shuningdek, yangi yechimni ishga tushirishni rejalashtirganlar, o'zlarining dala monitoringi ilovalariga talabni sezilarli darajada oshirishi mumkin.

Satellite monitoring of crops is a technology for monitoring changes in the vegetation index obtained using spectral analysis of high-resolution satellite images. It is used in individual fields or for individual crops and allows you to track positive and negative dynamics of plant development. The difference in the dynamics of the vegetation index indicates an imbalance in development within a crop or field. This indicates the need for additional agricultural work in certain areas, therefore this technology is classified as a precision farming method.

Ekinlarning sun'iy yo'ldosh monitoringi - bu yuqori aniqlikdagi sun'iy yo'ldosh tasvirlarining spektral tahlili yordamida olingan o'simliklar indeksidagi o'zgarishlarni kuzatish texnologiyasi. U alohida dalalarda yoki alohida ekinlar uchun ishlatiladi va o'simliklar rivojlanishining ijobiy va salbiy dinamikasini kuzatish imkonini beradi. O'simliklar ko'rsatkichi dinamikasidagi farq bir ekin yoki dala doirasida rivojlanishning nomutanosibligini ko'rsatadi. Bu ma'lum hududlarda qo'shimcha qishloq xo'jaligi ishlariga ehtiyoj borligini ko'rsatadi, shuning uchun ushbu texnologiya aniq dehqonchilik usullari sifatida tasniflanadi.

Vegetation index - an indicator calculated as a result of operations with different spectral ranges of remotely sensed data and related to the parameters of vegetation in a given pixel of the image. The effectiveness of vegetation indices is determined by the reflectance properties. The calculation of most vegetation indices is based on the two most stable parts of the vegetation spectral reflectance curve.

O'simliklar indeksi - masofadan zondlash ma'lumotlarining turli spektrli diapazonlari bilan operatsiyalar natijasida hisoblangan va tasvirning berilgan pikselidagi o'simliklarning parametrlari bilan bog'liq ko'rsatkich. Vegetatsiya indekslarining samaradorligi aks ettirish xususiyatlari bilan belgilanadi. Ko'pgina o'simliklar indekslarini hisoblash o'simlik spektral aks ettirish egri chizig'ining eng barqaror ikkita qismiga asoslanadi.

NDVI (Normalized Difference Vegetation Index) - normalized relative vegetation index. The most common in agriculture, it characterizes the density of vegetation and allows farmers to assess germination, growth, the presence of weeds or diseases, as well as predict field yields. The index indicators are formed by satellite images of green mass, which absorbs electromagnetic waves in the visible red range and reflects them in the near infrared. The red zone of the spectrum (0.62 - 0.75 microns) corresponds to the maximum absorption of solar radiation by chlorophyll, and the near infrared zone (0.75 - 1.3 microns) has the maximum reflection of energy by the cellular structure of the leaf. That is, high photosynthetic activity leads to low reflectance values in the red region of the spectrum and high values in the near infrared. The interrelationship of these indicators allows you to clearly distinguish plants from other natural objects. As a result, you can get a full

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spectral analysis and identify areas where replanting, plant protection products or fertilizers are needed. The index is moderately sensitive to changes in the soil and atmospheric background, except in sparsely vegetated environments, and can be oversaturated in densely vegetated environments when the leaf area index (LAI) is high.

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

When we studied the study areas of the Boyovut district using NDVI (Normalized Difference Vegetation Index), we were able to observe the following process.

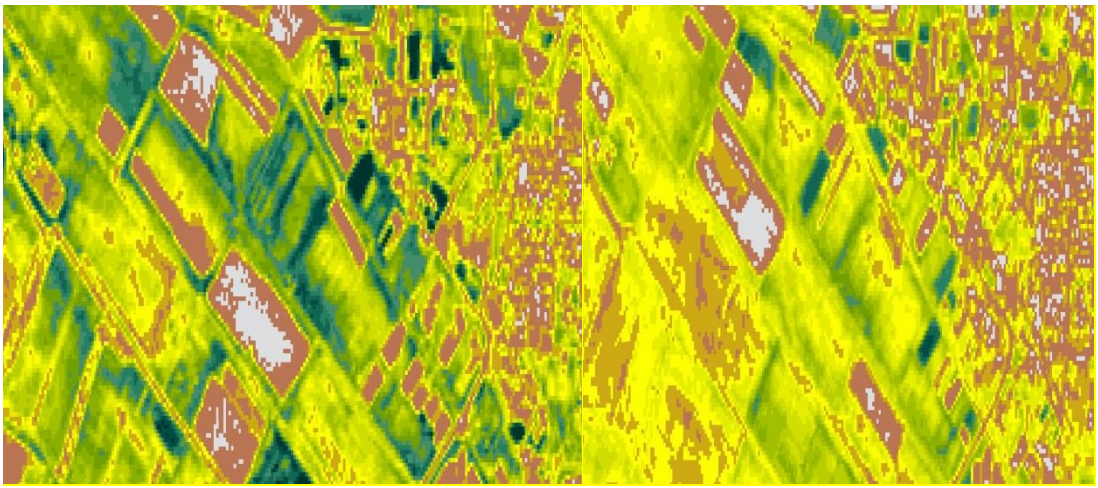

Figure 1. NDVI indicators of the region for 2017-2023.

Note. (dark green represents dense vegetation, brown represents sparse vegetation)

NDVI (Normalized Difference Vegetation Index) - normallashtirilgan nisbiy o‘simliklar indeksi. Qishloq xo‘jaligida eng keng tarqalgan bo‘lib, u o‘simliklarning zichligini tavsiflaydi va fermerlarga unib chiqishi, o‘sishi, byegona o‘tlar yoki kasalliklar mavjudligini baholashga, shuningdek, dala hosildorligini bashorat qilishga imkon beradi. Indeks ko‘rsatkichlari ko‘rinadigan qizil diapazonda elektromagnit to‘lqinlarni o‘zlashtiradigan va ularni yaqin infraqizilda aks ettiradigan yashil massaning sun’iy yo‘ldosh tasvirlari orqali shakllanadi. Spektrning qizil zonasi (0,62 - 0,75 mikron) quyosh radiatsiyasining xlorofill tomonidan maksimal singishiga to‘g‘ri keladi va yaqin infraqizil zona (0,75 - 1,3 mikron) bargning hujayra tuzilishi tomonidan energiyaning maksimal aks etishiga ega. Ya’ni, yuqori fotosintetik faollik spektrning qizil zonasida kam aks ettirish qiymatlariga va yaqin infraqizilda yuqori qiymatlarga olib keladi. Ushbu ko‘rsatkichlarning bir-biriga bog‘liqligi o‘simliklarni boshqa tabiiy ob’ektlardan aniq ajratish imkonini beradi. Natijada siz to‘liq spektral tahlilni olishingiz va qayta ekish, o‘simliklarni himoya qilish vositalari yoki o‘g‘itlarni qo‘llash kerak bo‘lgan joylarni aniqlashingiz mumkin. Indeks tuproq va atmosfera fonidagi o‘zgarishlarga o‘rtacha darajada sezgir bo‘lib, siyrak o‘simlikli muhitlar bundan mustasno va barg maydoni indeksi (LAI) darajasi yuqori bo‘lganda, zich o‘simlikli muhitda haddan tashqari to‘yingan bo‘lishi mumkin.

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

Boyovut tumani hududi tadqiqot maydonlarini NDVI (Normalized Difference Vegetation Index)

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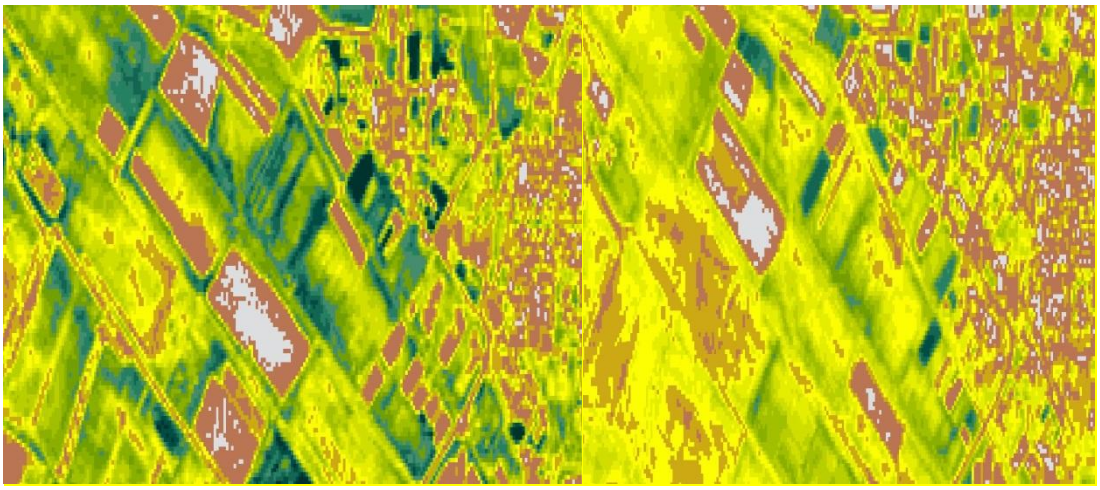
o‘rganganimizda quyidagi jarayonni kuzatish imkoni yaratildi.



1-rasm Hududning 2017-2023 yillardagi NDVI ko‘rsatkichlari.

Izoh.(to‘q yashil rang zich o‘simliklarni, jigarrang esa siyrak o‘simliklarni ifodalaydi)

When we study the soil cover and vegetation density of the area through NDVI indicators between 2017 and 2023, we can see that dense vegetation has decreased significantly in 2023 compared to 2017, and has been replaced by sparse vegetation. We can also see that vegetation was much denser in this area five years ago.

NDVI ko‘rsatkichlari orqali hudud maydonlarining tuproq qoplami va o‘simliklar joylashish ko‘rstkich miqdorini 201-2023 yillar oralig‘idagi vaziyatni o‘rganganimizda 2017 yilga nisbatan 2023 yilda zich o‘simliklar ancha kamayganligini, uning o‘rnini siyrak o‘simliklar egallaganini ko‘rishimiz mumkin. Shuningdek besh yil oldin bu hududda o‘simliklar ancha zich joylashganligini ko‘rishimiz mumkin.

In conclusion, we can say that currently, the soil cover of the region has deteriorated significantly due to reclamation, as a result of which the salt-water regime has been disrupted, and due to the continuous drought that has been observed for the past five years, we can observe that the vegetation cover is becoming sparser year by year.

Xulosa qilib aytish mumkinki hozirgi kunda hudud tuproq qoplami ancha meliorativ holati yomonlashganligi, natijada tuz-suv tartiboti buzilganligi va keying besh yil davomida muttasil qurg’oqchilik kuzatilayotganligi sababli yildan yilga o’simlik qoplami siyraklashib borayotganligini kuzatishimiz mumkin.

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