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Literature

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Monitoring of land cover using satellite images on the example of the Fergana Valley of Uzbekistan

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Annotation: Sites for studying plants and forests of the Fergana Valley for 2000 and 2018 were analyzed using the remote sensing method. Archival images of Landsat satellite, cadastral map and city plan, satellite data of higher resolution Canopus and Rapid Eye were used for research. The data obtained indicate that over the past 18 years in the study area, there has been an increase in the fragmentation of urban forest areas and a significant reduction in the class of deciduous and mixed plantations from 28108.40 hectares to 27906.46 hectares. The accuracy of the data obtained is confirmed by modern criteria of geoinformation statistics. The proposed method of thematic mapping and assessment of urban forests using remote sensing methods for landscape indicators will reduce the cost of work in comparison with ground-based studies and increase their accuracy.

Keywords: remote sensing, satellite monitoring, GIS, forest cover, satellite image, research, thematic map, GIS technology, forecast, Normalized difference vegetation index

INTRODUCTION

The relevance of research.

Currently, using satellite images, you can get high-quality and accurate information about the vegetation cover in different areas of the territory. Unfortunately, satellite imagery is not used in Uzbekistan to study vegetation cover. In this regard, it is necessary to carry out the temporal dynamics of the vegetation cover, draw the correct conclusions and analyze thematic maps. To do this, we must be based on concrete results of work. Satellite images give us evidence and accurate results for this.

The purpose and objectives of the study

The aim of the study is to analyze the time series of the dynamics of the vegetation cover of the Fergana Valley of Uzbekistan by means of remote sensing of the Earth.

To achieve this goal, the following tasks have been completed:

1. Conducting field research.
2. Selection of satellite images for the study area
3. Formation of thematic maps of vegetation cover
4. Assessment of the accuracy of thematic maps
5. Analysis of the dynamics of vegetation cover

Scientific novelty of work

For the first time, the analysis of time series of dynamics of vegetation cover on the territory of the Fergana Valley of Uzbekistan was carried out using data from remote sensing of the Earth. The technique of the dynamics of vegetation cover in the study area based on satellite images of medium resolution Landsat is presented.

Objects and subject of research

The objects of the study were the areas of forest and non-forest lands on the territory of the Fergana Valley of Uzbekistan.

The personal contribution of the author consists in collecting field material, selecting and laying test sites, processing it, classifying, analyzing and summarizing the results obtained.

The reliability and validity of the research is based on the involved experimental material of the test areas, which is the object of research, complex and systematic approaches to the implementation of the tasks (using static methods for processing experimental data).

The practical significance of the results obtained. The data obtained on the dynamics of vegetation cover, made on the basis of satellite images at different times, are of great practical interest among forest tenants and forestry workers. Such information allows you to quickly track ongoing changes, plan forestry activities, and improve forecasts for the development of forest landscapes and territories.

In addition, tracking the dynamics of vegetation cover is necessary for their further assessment. Therefore, remote sensing techniques using satellite imagery data are of practical value to owners of such land.

Basic research methods

Technique for processing satellite images, the formation of classes of generalized legend of vegetation cover, a technique for the formation of a thematic map.

The main result of the work:

Thematic maps on the territory of the Fergana Valley of Uzbekistan.

Since the 90s, international and national programs have been carried out to develop the capabilities of global satellite mapping of vegetation cover. The results of these projects are used to assess forest resources, ensure food security, assess impacts and predict climate change modeling.

However, despite the ongoing efforts, the methodological and technological aspects of satellite mapping of vegetation cover over large areas still require significant development. In the opinion of a group of scientists from the Space Research Institute of the Russian Academy of Sciences (Russian Academy of Sciences), this situation is explained by the conceptual complexity of the problem of mapping vegetation, if it is necessary to automate the processing of satellite data as much as possible using algorithms that ensure high accuracy of recognition of land cover objects in conditions of spatio-temporal variability. spectral and reflective characteristics [1].

Forest vegetation cover of the Volzhsky forestry of the Republic of Mari El based on the analysis of multi-temporal multispectral satellite images of medium resolution Landsat using GIS technologies. As a result of the work, an overview of existing GIS projects on thematic mapping of forest vegetation cover based on the use of satellite imagery data was made. A method for monitoring disturbed forest lands was developed and applied to remote sensing data in a GIS environment [2].

The upper border of forests is highly dependent on the degree of humidity of the climate; in more humid conditions, on average, it goes higher, in arid conditions - lower, that is, the upper boundaries of the growth of trees and shrubs do not always coincide with the same isotherm. In the conditions of Central Asia, including the Southwestern Tien Shan, the lower boundaries of the forests are extremely diverse not only in height, but also in the composition of the dominant species of woody plants, in the structure and environment-forming impact of forest communities that go beyond the lower limit. The lower limit of the forest is the degradation of forest flora, where continuous shrub formations of forest flora dominate, which are a transitional link between forest and steppe belts [3].

A number of types of pastures have been identified in the Fergana Valley: xerophilic-semi-shrub pastures on stony-gravelly soils, mountain and adyr steppe and meadow-steppe pastures, mountain-meadow and forest pastures. Further, knowing the coordinates of the location of certain lands on the MODIS map, these coordinates were marked in the Google Earth program. Thus, the areas of distribution of the main agricultural crops and territories prone to waterlogging or desertification were identified on satellite images. In other words, comparing the data of MODIS maps with space images of Google Earth and Landsat-7, it was revealed how different types of natural and anthropogenically modified complexes are displayed on the images [4].

Research program

Currently, using satellite images, you can get high-quality and accurate information about the vegetation cover in different areas of the territory. Unfortunately, satellite images are not used to study vegetation cover in the Fergana Valley of Uzbekistan. In this regard, it is necessary to carry out the temporal dynamics of the vegetation cover, draw conclusions and analyze thematic maps. To do this, we must be based on concrete results of work. Satellite images give us evidence and accurate results for this.

Purpose of the study– to analyze the time series of the dynamics of the vegetation cover of the Fergana Valley of Uzbekistan by means of remote sensing of the Earth. To achieve this goal, the following research tasks were solved:

1. *Conducting field research.*
2. *Selection of satellite images for the study area.*
3. *Formation of thematic maps of vegetation cover.*
4. *Assessment of the accuracy of thematic maps.*
5. *Analysis of the dynamics of vegetation cover.*

Research objects

Cameral research

The vegetation monitoring procedure included a number of the following stages of work carried out in the ENVI 4.8 and ArcGIS 10 software packages:

1. Selection of satellite images for the formation of thematic maps for the study area.
2. Radiometric and geometric processing of 1G level images.
3. Geolocation of Landsat images in ArcGIS 10.3.
4. Creation of thematic maps for 2000 and 2018. by the method of unsupervised classification by the "IsoData" method in the PC ENVI 5.2.
5. Assessment of the accuracy of the generated thematic maps in PC ENVI 5.2.
6. Assessment of the dynamics of vegetation cover.

Selection of satellite images for the formation of thematic maps for the study area.

The next stage of the work was the selection of satellite images for the formation of thematic maps for the study area in order to further track the dynamics of the vegetation cover.

The choice was made among the multi-temporal multispectral satellite images of Landsat TM and ETM + for the study area, which were used in the work. All images, in turn, underwent radiometric and geometric correction procedures.

As a result of a detailed analysis, the images of 2000 and 2018 were selected for work, which are the most consistent with the goals and objectives of our study.

Atmospheric correction - correction for the influence of the atmosphere, which determines the location of the shooting ranges due to transparency windows.

Before the formation of a thematic land cover map, a legend was created, which highlighted the main classes of land cover.

We used two Landsat images from 2000 and 2018.

The classification was carried out in several stages.

At the first stage, the primary classification of the original image into 25 classes (25 iterations) was carried out, after which two classes were identified - settlements and water bodies. The “settlements” class, in turn, underwent an additional classification with its subsequent division into classes (settlements, vegetation cover of settlements and areas devoid of vegetation).

At the second stage, the classes "settlements" and "water bodies" in the form of masks were removed from the original image.

With the resulting image, a secondary classification was carried out (Figure 5) into 25 classes (25 iterations), as a result of which 2 classes were identified - forest and non-forest lands.

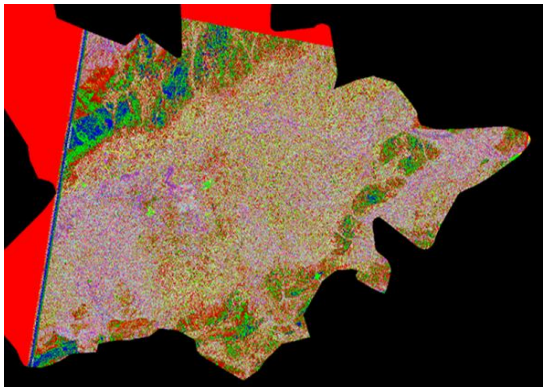

Figure 5 - Primary classification of the 2000 image into 25 classes

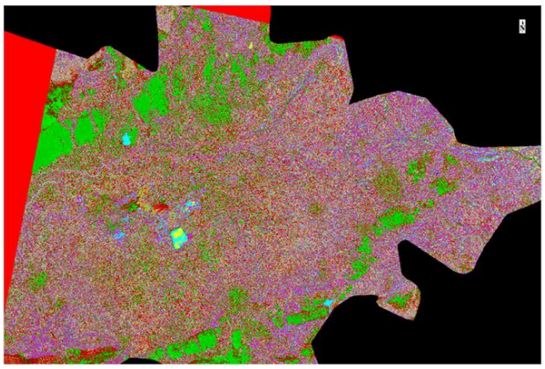

Figure 6 - Classification of satellite imagery in 2018 by the IsoData method in the PC ENVI into 20 classes

Further work continued with each class separately.

For example, the “forest land” class identified in the form of a mask was classified into 14 classes, followed by the identification of smaller classes of vegetation cover (coniferous, deciduous, mixed stands).

All the layers of the thematic map went through a similar secondary classification procedure until the final classes were selected.

RESULTS OF THE STUDY

Field studies

As a result of field studies, 90 test sites were established in the Fergana Valley of Uzbekistan. The coordinates of the location of each test site were recorded using a GARMIN eTrex GPS receiver. All data were recorded in the accounting records (table 2).

Table 2 - Characteristics of test sites in the Fergana Valley of Uzbekistan

Test section №	District	Planting composition	Average height	Average diameter
1	Fergana Valley, Andijan region, Balikchi district	Poplar	15 м	12 м
		Maple silver	28 см	15 см
2	Fergana Valley Bogishamol	Plane maple / Platan leaved maple	24 м	50 см
		Alder gray	16 м	35 см

		Norway spruce	30 м	25 см

Monitoring of vegetation cover in the Fergana Valley of Uzbekistan

According to the thematic map for 2000, the area of arboreal and shrubby vegetation amounted to 4733.82 thousand hectares, deciduous plantations - 28108.40 thousand hectares, shrubs - 16762.52 thousand hectares, herbaceous vegetation - 150313.32 thousand hectares (Table 3.2).

Table 3 - Areas of land cover classes for 2000

Class	**Area, thousand hectares**
Arboreal and shrubby vegetation (Rosemary willow, Narrow-leaved willow)	4733,82
Deciduous plantations (willow)	28108,40
Shrubs	16762,52
Herbaceous vegetation (cattail, reed, sedge)	150313,32

According to the thematic map for 2018, the area of arboreal and shrubby vegetation amounted to 5297.54 thousand hectares, deciduous plantations - 27906.46 thousand hectares, mixed - 6039.61 thousand hectares, herbaceous vegetation - 168751.40 thousand hectares (Table 3.3).

Table 4 - Areas of land cover classes for 2018

Class	**Area, thousand hectares**
Arboreal and shrubby vegetation (Rosemary willow, Narrow-leaved willow)	5297,54
Deciduous plantations (willow)	27906,46
Mixed plantings (Norway spruce, Walnut)	6039,61
Herbaceous vegetation (cattail, reed, sedge)	168751,40

Forest area in the study area of the Fergana Valley for 2000 and 2018 are different and have an uneven distribution pattern. Areas of tree and shrub vegetation decreased over the studied period of time, but other types of forest plantations were preserved. At the same time, forest plantations are being created in these territories. The reasons for such changes are the influence of natural factors, for example, a sharp increase in temperature, as well as anthropogenic activity.

In the city of Andijan in the Republic of Uzbekistan, tree and shrub vegetation such as chestnuts and walnuts are being planted. Almonds, pistachio trees, persimmons, jida, unabi, pomegranates, wine trees (yellow and black figs), laurel and various fruit trees for the garden grow in the urban areas. In recent years, many lemonarias and kiwis have appeared in the city of Andijan and its suburbs. The suburbs of Andijan, especially the foothills, are rich in fir and juniper forests, sea buckthorn groves, in the east of the region - walnut forests.

The decrease in the areas of mixed and deciduous stands is due to the fact that by the end of 2018 there was massive deforestation in the Fergana Valley (Figure 3.5).

Figure 12 - Pine felling in Andijan (October 16, 2018) in the Fergana Valley of Uzbekistan

Figure 13 - Damage to trees by pests and diseases

As a result of the expansion of roads, protective green spaces have recently been cleared. This is also reflected in the change in areas on the 2018 thematic map compared to the 2000 map.

Everyone knows that excess moisture negatively affects most plants. The main reason for this is lack of air, as a result of which crops die from pollution, tree roots rot. In this regard, pathological changes have an impact on the state of forest plantations (Figure 3.6). In the study area, forests, which are dominated by willow plantations (poplars), are negatively affected.

CONCLUSIONS AND RECOMMENDATIONS

The work carried out a systematic analysis of domestic and foreign literary sources, considered the existing methods, problems and solutions in the field of remote sensing in forestry. In addition, the ways of improving their quality based on the methods of foreign researchers are analyzed.

The paper also presents theoretical provisions on the formation of thematic maps of the vegetation cover in the Fergana Valley of Uzbekistan.

When comparing the images, an analysis was made of changes in the areas of forest areas, green zones. Among them are the districts adjacent to the Syrdarya river: Mingbulak district, Namangan region, Pap district, Namangan region, Dangara district, Fergana region, Ulugnor district, Andijan region and others.

The processes of transformation and degradation of vegetation cover taking place on the territory of the Fergana Valley of Uzbekistan require immediate analysis and taking measures to eliminate them. The use of remote sensing means allows obtaining reliable materials with the help of which it is possible to carry out a qualitative assessment and monitoring of the vegetation cover of the Fergana Valley.

The processes of transformation and degradation of vegetation cover taking place on the territory of the Fergana Valley of Uzbekistan require immediate analysis and taking measures to eliminate them.

The results of using remote sensing tools made it possible to obtain reliable materials that are needed for the subsequent assessment and monitoring of the vegetation cover of the Fergana Valley.

In addition, a methodology for mapping the vegetation cover in the studied territories using satellite images of medium resolution Landsat is presented. The information obtained makes it possible to promptly track ongoing changes, plan forestry activities for the maintenance of forest plantations, as well as improve forecasts of the development of forest landscapes and territories.

The methodology developed in the master's thesis will improve the efficiency of research and development work and the activities of well-known forestry enterprises, improve the quality of development results.

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