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DETERMINATION OF AGRICULTURAL LAND ILLEGAL USE ACCORDING TO REMOTE SENSING DATA

Abstract. *Unregulated anthropogenic pressure on rivers is a widespread phenomenon. The ecological state of the river basin is undergoing significant changes due to the emergence of new agricultural land in the river basin. The relevance of identifying illegal development is extremely high. This study is devoted to the identification of objects of illegal construction of agricultural land on satellite images using remote sensing data, processed with the help of software implemented in the program Visual Studio C#. The features of the program created by the author for tracking new objects in the waters of the Siverskyi Donets River are considered. The processed satellite images and their probability estimates of some areas of the Siverskyi Donets River basin are presented. The results allow remote sensing data to locate illegal development and assess misuse of land in the river basin.*

Keyword: anthropogenic load, river basin ecology, illegal construction, inappropriate use of agricultural land

The problem of unregulated use of agricultural land in the Siverskyi Donets River basin is quite widespread. The process of tracking the appearance of new objects on agricultural land is quite long and complicated. Therefore, to simplify it, we propose a program that can be used to identify objects on a satellite image of agricultural land for further inspection by a specialist, identify illegal construction on them, and check their compliance with the intended purpose.

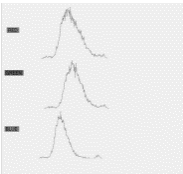
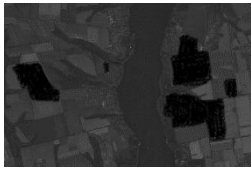
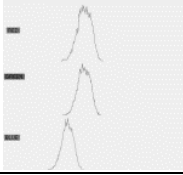
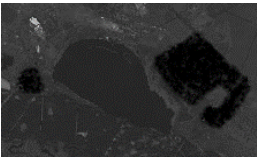
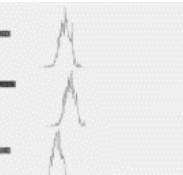
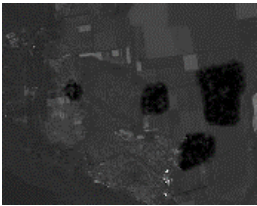
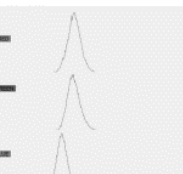
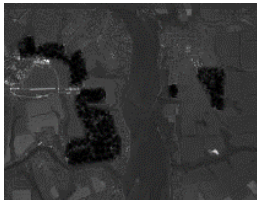
The program processes images of agricultural land based on the brightness of certain objects, visualizing them in the form of brightness values histograms. It was written in the Microsoft Visual Studio software environment in the C# object-oriented programming language.

To test the developed program, we selected satellite images of the Siverskyi Donets River basin near the Kharkiv Region villages, obtained from the Sentinel-2 satellite, in particular, Levkivka village, Ivanivka village, Dibrovo village, Lysohirka village and Chervonyi Donets village. On these images, we select pixels that fall within certain brightness limits in the entire file. This makes it possible to identify illegal construction by comparison pixels of the satellite image whose brightness characteristics correspond to the pixels of agricultural objects and checking the location of the selected object in relation to compliance with the rules and regulations on the location of construction on agricultural land. This makes it possible to identify illegal construction on a satellite image by comparing the pixels of these objects with the brightness characteristics of the images, which correspond to the pixels of agricultural land. There is also an opportunity to check the location of the found construction object for compliance with the norms and

rules of its location on agricultural land. The algorithm for selecting objects with certain brightness characteristics includes the following stages.

At the first stage, we mark with a rectangle the object that is definitely an object of agricultural land. We subsequently build a histogram of brightness values this object (examples of histograms are shown in Table 1). The obtained brightness values for the selected object are stored in the corresponding brightness file as reference values.

Table 1 – Table of analysis of objects in the images in the Siversky Donets River

| Settlement | Histogram of probabilities | Processed territory image |
|--------------------------|---|---|
| | Agricultural land objects | |
| Chervonyi Donets village |  |  |
| Lysohirka village |  |  |
| Levkivka village |  |  |
| Ivanivka village |  |  |

The second stage involves reading from the generated file and comparing the brightness values from the file with the brightness values of the rest of the image. The coincidence of the brightness values of objects in the image with the reference values is marked in black. In Table 1 shows the images with marked black zones, which probably correspond to the category of agricultural land.

At the third stage, the analyst forms a final conclusion on the category of objects on the analyzed image. When analyzing the objects selected by the program, the analyst uses a table of decryption signs of objects. By comparing the characteristics of the objects on the satellite images with the characteristics in the table of decryption signs, the analyst can make a conclusion about the accuracy of the program's selection of objects and their compliance with applicable rules and regulations. It is important to note that the image of arable land and similar agricultural land has a pronounced geometric shape of contours, variegated colors and often a specific striped-line pattern that reflects the effects of soil cultivation or planting. Lower areas have relatively higher humidity, so they appear in a darker tone on the image. Thus, the darkening of certain areas of the image of arable land, it is possible to judge the presence of farmlands there.

Another actual task, solved with the use of the developed program, is the task of assessing the compliance of the location of development objects with building codes and regulations.

In order to protect surface water bodies from pollution and fouling and to preserve water availability along water bodies within water protection zones, land plots are allocated for coastal protection strips, which are established on both banks of rivers and around water bodies along the water's edge (in the low water period) with a width of:

1) for small rivers, streams and brooks (catchment area up to 2,000 km²) and ponds with an area of less than 3 hectares – 25 meters;

2) for medium-sized rivers (catchment area of 2,000 – 50,000 km²), reservoirs on them, reservoirs, and ponds with an area of more than 3 hectares – 50 meters;

3) for large rivers (catchment area of more than 50,000 km²), reservoirs on them, and lakes – 100 meters.

The practical application of the developed program made it possible to analyze the river valley in retrospect. For example, a modern image of the Ivanivka village shows that buildings have appeared in the river valley 70 meters from the river bank, which violates state building codes and regulations. Similar gross violations of the Ukrainian legal framework were recorded near the Chervonyi Donets village (the distance of the building to the river bank is 82 meters), near the Savintsy urban-type settlement (82 meters), and near the Balakliia city (50 meters from the river bank). Of course, the above examples are only a fraction of the illegal developments that exist in the Siverskyi Donets River valley and violate the current legislation, contribute to changes in the morphometric and hydrological characteristics of the Siverskyi Donets River.

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