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ASSESSMENT OF DEFORESTATION IN THE IVANO-FRANKIVSK OBLAST BASED ON REMOTE SENSING DATA

Deforestation is one of the urgent problems in the world. Deforestation is caused by natural and anthropogenic factors, therefore the need to monitor this problem is urgent. An operational and low-cost monitoring method for detecting deforestation is the use of remote sensing data. Thanks to satellite information, it is possible to solve several tasks related to the diagnostic assessment of this process and the development of recommendations for solving this problem [1-2].

In Ukraine, the problem of deforestation is large-scale, due to deforestation. Since our country is forest-deficient, the problem of deforestation is urgent and must be solved. The problem of deforestation has been studied by many scientists [3-11].

Ivano-Frankivsk Oblast was selected as the study area to assess the state of the forest cover, it is in this region that part of the Ukrainian Carpathians is located.

The online platform for working with space images Google Earth Engine (GEE) and the "Hansen dataset" database, which uses data from Landsat satellites since 2000, were used for calculations [12-14].

To assess the state of deforestation in the Ivano-Frankivsk oblast based on the remote sensing data, a program code was written in the JavaScript programming language, which is shown in (Figure 1).

```
Imports (1 entry)
  var geometry: Table users/businka0053/Ivano-Frank
1 var gfc2022 = ee.Image("UMD/hansen/global_forest_change_2022_v1_10");
2 var treeCoverCha_Vis = {
3   min: 0,
4   max: 100,
5   palette: ['black', 'green'],
6   bands: ['treecover2000']
7 }
8 Map.addLayer(gfc2022.clip(geometry), treeCoverCha_Vis, 'Hansen2000');
9 var lossImage = gfc2022.select(['loss']);
10 //Mapping tree cover loss from 2000
11 // Add the loss layer in red.
12 Map.addLayer(lossImage.clip(geometry).updateMask(lossImage),
13   {palette: ['FF0000']}, 'Loss');
14 // Get the loss image.
15 // This dataset is updated yearly, so we get the latest version.
16 var lossImage = gfc2022.select(['loss']);
17 var lossAreaImage = lossImage.multiply(ee.Image.pixelArea());
18 var lossYear = gfc2022.select(['lossyear']);
19 var lossByYear = lossAreaImage.addBands(lossYear).reduceRegion({
20   reducer: ee.Reducer.sum().group({
21     groupField: 1
22   }),
23   geometry: geometry,
24   scale: 30,
25   maxPixels: 1e9
26 });
27 print(lossByYear);
```

Fig. 1. JavaScript program code for assessing the state of deforestation in the Ivano-Frankivsk oblast in the period from 2001 to 2022

For the period from 2001 to 2022, the results of deforestation of the studied territory were obtained, which are shown in (Figure 2).

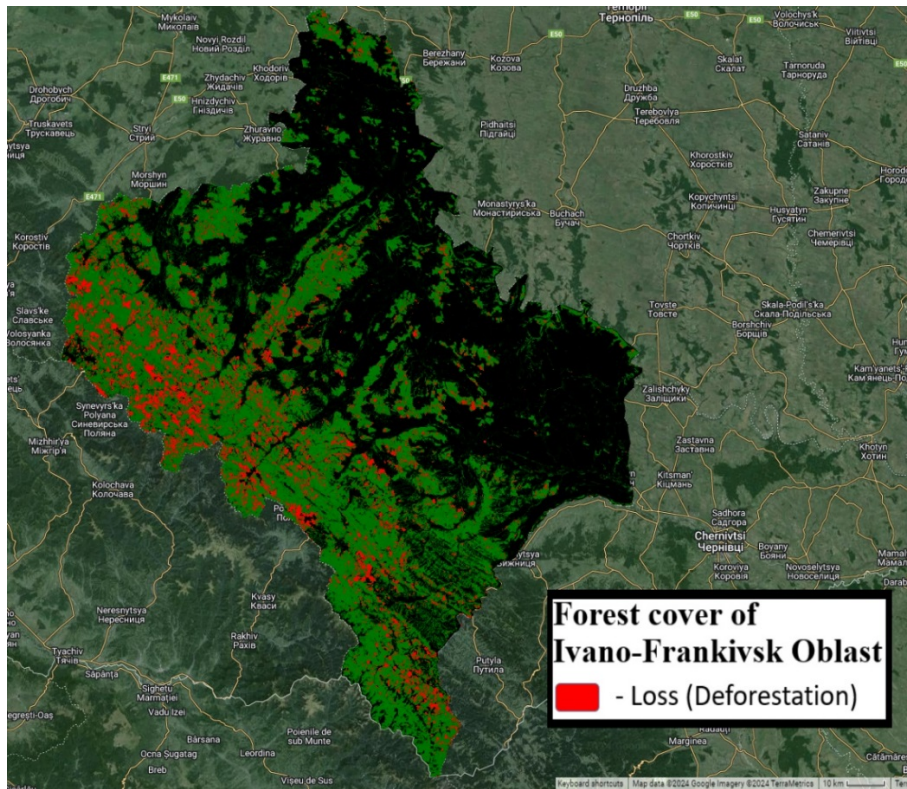


Fig. 2. Deforestation map of Ivano-Frankivsk Oblast for the period from 2001 to 2022

The forest cover change map of the Ivano-Frankivsk oblast shows the area of deforestation in red. Analysis of Fig. 1 shows that in the western and southern parts of Ivano-Frankivsk oblast, there are more areas with intensive deforestation over the past 22 years compared to the center and east of Ivano-Frankivsk oblast. One of the features, why the level of deforestation in the western and southern parts of the Ivano-Frankivsk oblast is higher than in other parts of the oblast, is that the territory of the Carpathians is located in the western and southern parts of the oblast, which have a large area of forests and forest ecosystems on their territory.

The Google Earth Engine online application provided data in CSV format and plotted the loss of forest cover in the Ivano-Frankivsk oblast for each year from 2001 to 2022.

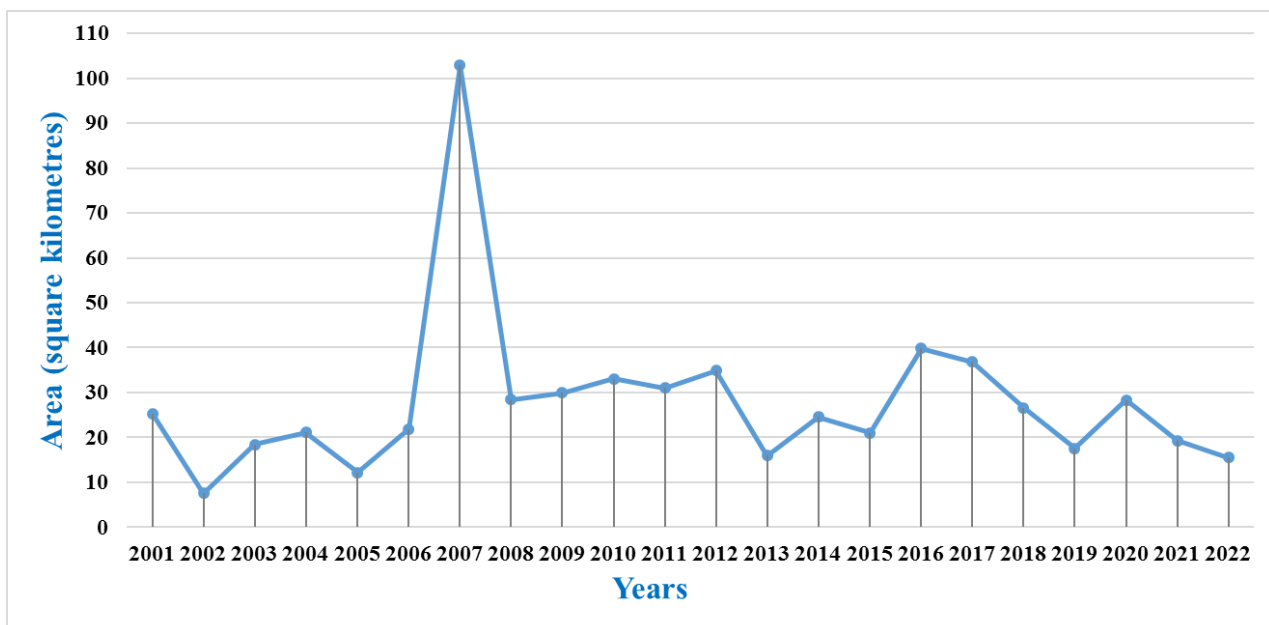


Fig. 3. Areas of deforestation in the Ivano-Frankivsk oblast for the period 2001-2022

The results of the graph (Figure 3) showed that for the period from 2001 to 2022, the greatest loss of forest cover in the Ivano-Frankivsk oblast was in 2007 and it amounted to 102.91 square kilometers. The

smallest losses were in 2002 and they amounted to 7,523 square kilometers. According to the dynamics of deforestation, it can be noted that starting from the peak year of 2007, the level of loss decreased, but it was greater than in the period between 2001 and 2006. In the period from 2008 to 2012, the loss of forest cover gradually began to increase. Between 2013 and 2015, the rate of deforestation decreased. In 2016, the level increased but then began to decrease. In 2020, the level increased and between 2021 and 2022 gradually began to decrease, and in 2022 the area of deforestation was 15.54 square kilometers.

So, the total area of forest cover loss in the Ivano-Frankivsk oblast for the period from 2001 to 2022 was approximately 612.25 square kilometers.

The problem of deforestation is not only for the Ivano-Frankivsk oblast but also for the entire territory of Ukraine, that is, it is a nationwide problem and it is necessary to develop an action plan, carry out the necessary reforms, and implement norms and amendments to laws, improve our legislation and ratify the norms of the European Union in our legislation to solve the problem of the destruction of forest cover in our state.

Further research will be aimed at determining the deforestation of the forest massifs of the Carpathian Mountains and Ukrainian Polissia.

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