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COMPARISON OF REMOTE SENSING AND CADASTRE DATA FOR DETERMINATION OF LAND DEGRADATION IN LATVIA

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Introduction.

In recent years is important to determine the land degradation and to take measures to prevent it. To carry out land degradation prevention measures, initially should determine the territories of degraded land. These territories can be identified differently – performing field work or performing data analysis. However, with the development of technologies and experience of land degradation assessment methods in the world, one of the most important developments has been use of remote sensing data – satellite images and orthophoto maps. Processing satellite images and orthophoto maps with appropriate software, the information is obtained on degraded land areas that serve as a basis for further land degradation limitation and prevention measures for various institutions.

According to the State Land Service data, 19.2 % of agricultural land, including ameliorate lands, in Latvia currently is not used and they are gradually overgrown with weeds and bushes, therefore there is already begun the process of land degradation [1].

In order to promote sustainable use of land should prevent the causes and consequences of land degradation.

Using the remote sensing method often about the object can get the information that cannot be seen with the naked eye. This invisible information can be obtained with electromagnetic radiation, which is registered with a passive sensor. Remote sensing is based on two factors:

- electromagnetic radiation consisting of electromagnetic waves,
- objects and materials ability to reflect, to change the electromagnetic radiation.

Aim of the paper is to explore the application possibilities of remote sensing and cadastre data for determination of land degradation. To achieve the aim, the following tasks were set:

- gather remote sensing and cadastre data;
- process the obtained data;
- use the obtained results for determination of land degradation.

Materials and Methods

In result of previous studies [2] were developed scheme – use of remote sensing data for determination of land degradation, which was used in this study.

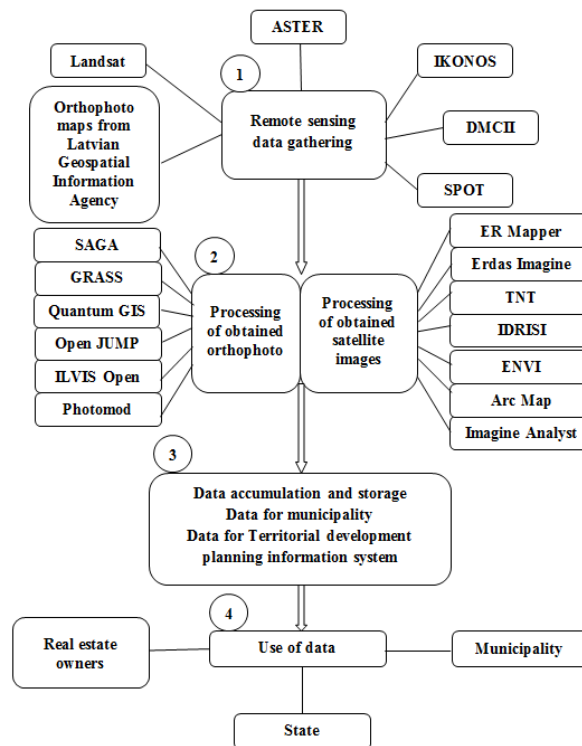


Fig. 1. Use of remote sensing data for determination of land degradation

Use of remote sensing data for determination of land degradation could be divided in 4 stages:

1. Remote sensing data gathering. If it is necessary to obtain data about the object from the distance, you may use the available satellite images or orthophoto maps. Satellite images can be obtained from remote sensing programs: Landsat, ASTER, IKONOS, DMCII, SPOT.

Carrying out remote sensing by aerial photography were used the Latvian Geospatial Information Agency orthophoto, scale of 1:10 000, which are freely available at the website of Latvian Geospatial Information Agency.

In Latvia orthophoto maps are prepared in Latvia Coordinate System LKS-92 TM in accordance with the TKS-93 division of map sheets (scale 1:10 000 map sheet complies with the 5x5 kilometers in nature). For the entire territory of Latvia the orthophoto maps are completed in TIFF format, scale 1:10 000 [3].

Orthophoto maps are available from 1994. Without publicly available orthophoto maps it is possible to conduct its own aerial photography but it is a paid service.

2. Processing of obtained orthophoto and satellite images. Orthophoto can be processed in computer programs: Microstation, SAGA, GRASS, Quantum GIS, Open JUMP, ILVIS Open and Photomod. In this research orthophoto were processed in Microstation software. In Microstation software orthophoto maps can be connected with the State Land Service spatial data to calculate the necessary areas and perform other functions.

For processing of satellite images also is offered a very wide range of data processing programs, for instance, Erdas Imagine Professional, Arc Map, Arc GIS, IDRISI, ER Mapper, Image Analyst, ENVI, TNT, PCI Geomatic un others.

3. Data accumulation and storage. According to the Latvian legislation it is intended that the supervision of degraded lands will be transferred to local governments. The local municipality in territorial development planning documents will define and mark degraded territories, and will foresee the necessary land-use conditions. The information about degraded lands is included and maintained in Territorial Development Planning Information System.

4. Use of data. After data processing, are obtained thematic maps or data of interest for a particular area. These data may be used by the real estate owners, municipalities, state institutions, such as the National Land Service

Results and Discussion

Using Latvian Geospatial Information Agency's available orthophoto data, were examined few land units, where could be observed the land degradation. The changes of land degradation can be compared over a longer period of time. Therefore there were compared four orthophoto maps, each taken in different period of time. In orthophoto maps the best could see the land degradation type – agricultural land overgrowing with bushes.

The first of the objects located in Engure municipality, Smarde municipality rural territorie. In

Fig. 2 can be seen aero photos from the location. The first aero photo was taken on June 26, 1994, in the image visible area is used for agriculture and is not overgrown with bushes. Situation changes begin to appear in the second aero photo, which were taken on June 4, 2007, where is visible that there begin to appear small bushes. The third aero photo, taken on June 19, 2011, clearly shows that the displayed area starts to overgrow with bushes. In the fourth aero photo, taken on June 3, 2013, must see that practically whole area is overgrown with bushes.

Fig. 3 shows the part of Smarde municipality rural territory's orthophoto map with the State Land Service Real Estate Cadastre Information System's spatial data for real estate "Indra" with the cadastre number 90820060099.

Table 1 shows real estate "Indra" land distribution by types of land use according to the State Land Service data [4].

Real estate "Indra" total area is 2.80 ha. The purpose of use is land on which the main economic activity is agriculture. From the land uses, the largest area is occupied by agricultural land – 2,75 ha. In the Land review data registered bush areas are 0,02 ha. Looking at June 3, 2013 orthophoto map, it shows that shrubs are all over the property area.

Since the State Land Service land report data do not meet the information visible in orthophoto map, in real estate "Indra" is necessary to carry out cadastral surveying in order to clarify the use of land and update cadastral data.

The second object is located in Engure municipality, Engure municipality rural territorie (Fig. 4). The first aero photo was taken on June 26, 1994, in the image visible area is used for agriculture and is not overgrown with bushes. In the next aero photo, taken on June 1, 2013, must see that practically whole area is overgrown with bushes.

Fig. 5 shows the part of Smarde municipality rural territory's orthophoto map with the State Land Service Real Estate Cadastre Information System's spatial data for real estate "Mezplavas" with the cadastre number 90500050939.

Table 2 shows real estate "Mezplava" land distribution by types of land use according to the State Land Service data.

Table 1

Real estate "Indra" land distribution by types of land use according to the State Land Service data

Cadastral number	Purpose of use of real estate	Types of use of the land unit	Area, ha	
90820060099	Land on which the main economic activity is agriculture	agricultural land	2,75	
		forest	–	
		shrubbery	0,02	
		swamp	–	
		water bodies land	land under the water	–
			land under fish ponds	–
		land under buildings and yards	–	
		land under roads	–	
		other land	0,03	
		Total:	2,80	

Table 2

**Real estate “Mezplavas” land distribution by types
of land use according to the State Land Service data**

Cadastral number	Purpose of use of real estate	Types of use of the land unit	Area, ha	
90820060099	Land on which the main economic activity is agriculture	agricultural land	4,79	
		forest	0,16	
		shrubby	–	
		swamp	–	
		water bodies land	land under the water	–
			land under fish ponds	–
		land under buildings and yards	–	
		land under roads	0,29	
		other land	0,42	
Total:	5,66			

Real estate “Mezplavas” total area is 5,66 ha. The purpose of use is land on which the main economic activity is agriculture. From the land uses, the largest area is occupied by agricultural land – 4,79 ha. In the Land review data shows the there is no registered shrubby areas. Looking at June 1, 2013 orthophoto map, it shows that shrubs are all over the property area.

Since the State Land Service land report data do not meet the information visible in orthophoto map, in real estate “Mezplavas” is necessary to carry out cadastral surveying in order to clarify the use of land and update cadastral data.

The third object is located in Engure municipality, Smarde municipality rural territorie. In Fig. 6 are clearly visible signs of land degradation – agricultural land overgrowing with bushes.

Fig. 7 shows the part of Smarde municipality rural territory’s orthophoto map with the State Land Service Real Estate Cadastre Information System’s spatial data for real estate “Duckopji” with the cadastre number 90820060050.

Table 3 shows real estate “Duckopji” land distribution by types of land use according to the State Land Service data.

Table 3

**Real estate “Duckopji” land distribution by types
of land use according to the State Land Service data**

Cadastral number	Purpose of use of real estate	Types of use of the land unit	Area, ha	
90820060099	Land on which the main economic activity is agriculture	agricultural land	11,50	
		forest	3,30	
		shrubby	–	
		swamp	0,20	
		water bodies land	land under the water	1,10
			land under fish ponds	–
		land under buildings and yards	0,40	
		land under roads	0,10	
		other land	–	
Total:	16,60			

Real estate “Duckopji” total area is 16,60 ha. The purpose of use is land on which the main economic activity is agriculture. From the land uses, the largest area is occupied by agricultural land – 11,50 ha. In the Land review data shows the there is no registered shrubby areas. Looking at June 3, 2013 orthophoto

map, it shows that shrubs are all over the property area.

Since the State Land Service land report data do not meet the information visible in orthophoto map, in real estate “Duckopji” is necessary to carry out cadastral surveying in order to clarify the use of land and update cadastral data.



June 26, 1994



June 19, 2011



June 4, 2007



June 3, 2013

Fig. 2. Aerophotos from the first object

*Fig. 3. Orthophoto map (June 3, 2013)
with the State Land Service Real Estate Cadastre
Information System's spatial data*





June 26, 1994



June 1, 2013

Fig. 4. Aerophotos from the second object*Fig. 5. Orthophoto map (June 1, 2013) with the State Land Service Real Estate Cadastre Information System's spatial data*

June 26, 1994



June 3, 2013

Fig. 6. Aerophotos from the third object*Fig. 7. Orthophoto map (June 3, 2013) with the State Land Service Real Estate Cadastre Information System's spatial data*

Conclusions

1. In order to promote the sustainable land use and prevent land degradation causes and consequences, looking at the world experience and development of technologies one of the most important development has been use of satellite images and orthophoto maps.

2. The research determined that the State Land Cadastre Service data does not comply with information visible in orthophoto maps, so it is necessary to carry out cadastral surveying of real estate "Indra", "Mezplavas" and "Duckopji" in order to clarify land use and update cadastral data.