

REMOTE SENSING OF DRAINED AGRICULTURAL LANDS

TÉLÉDÉTECTION DES TERRES AGRICOLES DRAINÉES

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ABSTRACT

Data on remote sensing monitoring of drained agricultural lands technical conditions in Leningrad region are presented. Driving factors affecting water-air regime of drained agricultural lands with expired warranty period of drainage systems are ascertained. Remote sensing methods for monitoring of separate elements of drainage systems on agricultural lands are discussed. Remote sensing methodology is recommended.

Keywords: Remote sensing monitoring; drained agricultural lands.

RESUME

L'article présente des données issues de la surveillance par télédétection de l'état technique des terres agricoles drainées dans la région de Leningrad. Il identifie les facteurs déterminants influençant le régime de l'eau et de l'air de ces terres lorsque la période de garantie des systèmes de drainage a expiré. Les méthodes de télédétection pour la surveillance des éléments séparés des systèmes de drainage sur les terres agricoles sont discutées. La méthodologie de télédétection est recommandée.

Mots-clés : Surveillance par télédétection; terres agricoles drainées.

INTRODUCTION

In the Leningrad region of Russian Federation has been developed and being running the program for an introduction into operation of non-operated agricultural lands. The program is running until 2030. Within the program, the following projects are carrying out: reconstruction and maintenance of drained agricultural lands, land clearance operations, introduction into operation of abandoned agricultural lands. The important work unit of a monitoring of technical conditions and a maintenance of drained agricultural lands is their inspection and soil water regime control.

In the annual report, based on the melioration and hydrological survey predicated on the "Operational Regulations of Drainage Systems", reclamation lands, drainage and irrigation systems conditions must be considered. [1] The data collection on drainage systems construction and reconstructions projects accuracy is carried out basing on the ground water monitoring wells observation, on care and maintenance conducted works, crop rotations, crops harvests and other criteria. Based on the obtained data melioration inventory there data on quantitative and qualitative melioration systems and constructions conditions and their changes statistics.

The remote sensing of drained land technical conditions allows using an economically less expensive way to make a conclusions on soils air and water regime, time frame for water disposal break up at drained areas, drainage stock accumulation, extra irrigation time scale, operative free water removal while flood rise. Through the years, the Agrophysical Research Institute applying remote sensing methods with using drone aerial vehicles. The technical conditions of drainage agricultural systems and single hydro technical units located within drainage system are being observed. The research is

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conducted on the drained areas, because irrigation is not widely used at the Leningrad region. The weather conditions allow growing a good yield on the drained areas without involving an extra cost on irrigation using an advanced technology in a crop research. The results of the observations and investigations are used for measures development on drainage systems conditions improvement and for the provisions of optimal water and air regime during a vegetation period.

The observations and investigations are costly affair and their results are doubtful in some of the cases, besides material losses due to unrepaired drainage systems are significant and count up to 20% of a crop yield loss. [2].

Interpretation of the air pictures, obtained by drone aerial vehicles in different spectral colors and satellite data allows obtaining the necessary information on the technical conditions of the drainage systems. Application of automatic weather measurements, field-water quality analyzers, ground water measurements, using of georadars and other measurement tools under regimes of control and fixation of geographical references of a research area basing on established procedures allows to increase work efficiency and to obtain reliable indicators of the research.

According to the current practice, monitoring of drained areas allows to determine only a local malfunction of the drainage system. The remote sensing determines malfunctioned drainage area more accurate by air pictures, which show the whole drainage system including water receiver, carrier channels and the other drainage constructions. The proposed approaches for remote sensing developed and tested by Agrophysical Research Institute allow to offer the method, reducing time and manual work of drainage engineers, to drainage systems owners and stockholders and let the to receive reliable figures and compile a statement of malfunctions for repair works.

The basis of methodology is analysis of high resolution air pictures obtained by drone aerial vehicles on drainage lands drained by opened channel systems or underground pipe drainage where separate elements of drainage system could be observed. For instance, on satellite images opened inlets, artificial ponds, reservoirs, barrages, food-breaking dams, separate hydro-technical constructions such as, bridges, pipeline crossings, intra-organizational roads, pylons, pump stations and other ground constructions of drainage system could be determined. However, high-quality pictures could be obtained during two months per ear, the other time territory of Leningrad region is cloudy and the necessary information can be received from air pictures from drone aerial vehicles air pictures.

By the crops conditions, on the survey drainage area at the particular vegetation period, drainage system technical condition can be implicitly determined, for this purpose in the different climatic zones of the Leningrad region were created 10 crop rotation diagnostic fields. The longstanding researches conducted on diagnostic fields allows to estimate risks of agricultural production, to make a crop yield fluctuation prognosis basing on weather conditions, applied agro technology, using a ground and a remote sensing data on a crop condition changes.

The remote sensing of drained agricultural system with remote sensing methods is recommended to carry out in the following sequence:

- The space images (aerial survey) obtaining for specified area and parameters.
 - A collection and a digitization of the project documentation for the researched agricultural system.
1. A field monitoring of the key constructions of the drainage systems for the determination of standard features of their operating conditions.
 2. A drainage construction photo (video) imagery to visually confirm its technical conditions with a time and a geolocation identification. Airborne vehicles for remote sensing is the most informative and precise method for both a visible light spectrum and an infrared band (especially)

3. A laboratory investigation of the space images, airborne images and ground images for determination of sings of malfunctioning (functioning) of particular drainage construction elements.
4. A determination of technical conditions of the drainage systems by the harvest of the past years on the research drained area.
5. A determination of weediness intensity of the drainage channels and agricultural fields by using the area and occlusion density, vegetation species and stem strength and comparing the data with model area weeded by the similar vegetation.



Figure 1. Fragment of the Project Documentation



Figure 2. Drainage system air picture fragment.

1. A crone volume calculation on the channel slopes and birms, release of the recommendations for their harvesting and utilization.
2. A wood clearance volume calculation (steam removal) with recommendations for the ways of their removal from channel slopes, birms and field areas.

3. A determination of the malfunction of a pipe drainage and collectors by the springtime space images interpretation by overlaying research area over wetting data on a pipe drainage area map to determine the drainage system element malfunction.
4. The wet spots localization and their area determination, release of the recommendations for the repairing and using of malfunctioned field.



Figure 3. Fragment of the air picture of the malfunctioned underground drainage system.

1. The channels physical dimensions and bottom set beds determination by using digital model of research area.
2. The construction of canal bottom and lateral dimension profile, calculation of construction volumes.
3. A data collection from remote sensors about drainage water quality, meteorological characteristics data collection and their transfer into a database.
4. The calculation of water supply and water disposal, technical conditions for the particular drainage system, potential fertility and harvest prognosis for the crop.

As the conclusion, the efficient land use at the Leningrad region is possible only with accurate air and water soils regime by application of agro melioration arrangements and well-timed repair and maintenance works on drained agricultural systems.

REFERENCES

Rules for the technical operation of drainage systems. Moscow, 1998.
Land reclamation handbook. St. Petersburg, 2009.