KnE Life Sciences

AgroSMART 2019
International scientific and practical conference
``AgroSMART - Smart solutions for agriculture''
Volume 2019

Knowledge E
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Conference Paper

Total Degradation of Agricultural Landscapes and Development of Matrices of Land Management Problems in Stavropol Region

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Abstract

The article is devoted to the problems of agricultural land management in Stavropol region in the context of agro-climatic zones characterized by degradation processes. The subject is a qualitative state of agricultural landscapes of Stavropol and their protection, identification of degradation processes. Materials are result of the research conducted in Stavropol region in 2000--2017 by monitoring agricultural landscapes, using satellite imagery and space photos. The original method of building matrices of main land management problems helps present a real situation in all agro-climatic zones of Stavropol. The results and their analysis make it possible to develop and implement zonal integrated anti-erosion measures which have a positive impact on agricultural production, quality of agricultural landscapes, and ecology of the region.

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Received: 25 October 2019
Accepted: 15 November 2019
Published: 25 November 2019

Publishing services provided by Knowledge E

Selection and Peer-review under the responsibility of the AgroSMART 2019 Conference Committee.

1. Introduction

Natural components are destroyed by human activities which leads to irreparable consequences. The qualitative state of agricultural land depends on many factors, but the main ones are natural conditions and anthropogenic impacts. Agricultural land is used to obtain maximum benefits, ignoring its condition and negative processes. Cadastral valuation and taxation of lands do not take into account development of degradation processes and their impact on the use of land plots.

Stavropol region is one of the largest agricultural regions producing more than 3 % of gross product. It is located in the central part of the Pre-Caucasus; its area is 6 616 thousand hectares. Stavropol region consists of 26 administrative districts and regional 10 cities. The territory has a very complex geological and geomorphological structure. The relief of was formed under the influence of two factors -- tectonic development and denudation-accumulative activities. The elevation differences vary from 5 to 1542 m above sea level. A third of the territory is y lowland plains with a height varying from 100 to 200 meters. Significant areas are lowlands and high plains (24.54 and 23.65 %,

respectively). About 8 thousand km^2 are elevations with a height of 350--500 meters above the sea level. All these facts can deteriorate the state of the land fund.

The territory has a pronounced inhomogeneous relief with large differences of heights. This relief contributes to the formation of wind corridors which cause wind erosion or deflation. Plowed plots, even with a slight slope, are subject to water erosion.

2. Problem Statement

Increasing intensity of the use of agricultural lands increased the area of degraded lands in the Russian Federation. The territory of Stavropol region belongs to the zone of risky farming due to climatic conditions and anthropogenic activities (over-plowed slope lands, poor irrigation, lack of control of livestock grazing, lack of anti-erosion measures).

It is rather difficult to assess the impact of degradation processes on agricultural production and land management in a particular territory, since there is only data on individual farms, municipal districts or agro-climatic zones.

Long-term monitoring of the development of degradation processes made it possible to identify negative phenomena that hinder the development of agriculture. The analysis of degradation processes in each administrative region and agro-climatic zone provides a basis for identifying specific negative phenomena in a certain territory which helps develop a matrix of land-management problems and a set of anti-degradation measures.

3. Materials and Methods

Materials are result of the research conducted in Stavropol region in 2000--2017 by monitoring agricultural landscapes, using satellite imagery and space photos.

The theoretical and methodological basis is general scientific methods (descriptive, comparative, statistical, cartographic, modeling and system analysis). The research methodology is based on general principles and approaches: systemic, integrated, integrated, ecological, and geographical ones.

Degraded lands of Stavropol region were identified in 2000--2016. The methodological basis for surveys was Methodological Recommendations for Identifying Degraded and Polluted Lands published in 1995.

4. Discussion

The results of 16-year monitoring of agricultural lands I of the agro-climatic zone of Stavropol region show that the main negative factors are as follows: salinity -- 644.3 thousand hectares, alkaline and solonetz complexes -- 462.8 thousand hectares, and deflation -- 245.3 thousand hectares. Large areas are subject to water erosion (195.4 thousand hectares) and joint water and wind erosion (47.3 hectares). The areas of other degradation decreased.

A matrix of main land management problems for administrative districts and agroclimatic zones was built (Table 1).

TABLE 1: Matrix of main problems in agroclimatic zone I.

No	District name	Main problems			
		1	2	3	4
1	Apanasenkovsky	Salinization	Alkaline and solonetz complexes	Water erosion	Waterlogging
2	Arzgirsky	Salinization	Water erosion	Alkaline and solonetz complexes	Deflation
3	Levokumsky	Salinization	Deflation	Alkaline and solonetz complexes	Erosion + deflation
4	Neftekumsky	Salinization	Deflation	Alkaline and solonetz complexes	Waterlogging
5	Turkmensky	Alkaline and solonetz complexes	Salinization	Water erosion	Deflation
agroclimatic zone I		Salinization	Alkaline and solonetz complexes	Deflation	Water erosion

Based on the results of monitoring, we have identified four problems of agricultural land management in agroclimatic zone I. Of all types of land degradation, only rockiness (0.6 thousand hectares) does not cause concern; waterlogging and swamp formation remain serious problems (74.4 thousand hectares and 3.6 thousand hectares, respectively). In addition, the amount of land exposed to the combined effects of water and wind erosion increased (47.3 thousand hectares). Therefore, measures aimed at conserving agricultural land are required.

Monitoring studies to determine degradation of agricultural land of agro-climatic zone II show that the largest areas of agricultural landscapes are subject to water erosion (281.6 thousand hectares), deflation (236.8 thousand hectares), salinization (182.9 thousand hectares) and distribution alkaline and alkaline complexes (114.4 thousand hectares). Large areas suffer from flooding, joint erosion and rockiness. Monitoring results were used to built a matrix of main problems of agricultural land management in the arid zone (Table 2).

Table 2: Matrix of main problems in agro-climatic zone II.

No	District name	Main problems			
		1	2	3	4
1	Alexandrovsky	Water erosion	Salinization	Rockiness	Alkaline and solonetz complexes
2	Blagodarny	Water erosion	Alkaline and solonetz complexes	Erosion +deflation	Deflation
3	Budennovsky	Water erosion	Salinization	Deflation	Erosion + deflation
4	Ipatovsky	Alkaline and solonetz complexes	Water erosion	Salinization	Waterlogging
5	Kursky	Deflation	Water erosion	Salinization	Waterlogging
6	Novoselitsky	Water erosion	Deflation	Erosion + deflation	Salinization
7	Petrovsky	Deflation	Water erosion	Salinization	Alkaline and solonetz complexes
8	Sovetsky	Salinization	Water erosion	Alkaline and solonetz complexes	Waterlogging
9	Stepnovsky	Water erosion	Salinization	Waterlogging	Rocky
agroclimatic zone II		Water erosion	Deflation	Salinization	Alkaline and solonetz complexes

As can be seen from Table 2, the main problem in t agroclimatic zone II is water erosion. Deflation, salinization and development of alkaline and solonets complexes are also big problems.

Agricultural land in agro-climatic zone III degraded to a large extent. Similar problems are typical for the zone of unstable humidification and other agroclimatic zones of Stavropol region. The distribution of their areas is significantly different. The main problems are water erosion (385.2 thousand hectares), salinization (356.8 thousand hectares), deflation (216.5 thousand hectares) and development of alkaline and solonetz complexes (195.8 thousand hectares). In some areas, the main problems are rockiness, water and wind erosion, and waterlogging (Table 3).

Table 3: Matrix of main problems in agroclimatic zone 3.

No	District name	Main problems			
		1	2	3	4
1	Andropovsky	Water erosion	Salinization	Alkaline and solonetz complexes	Waterlogging
2	Grachevsky	Water erosion	Salinization	Deflation	Alkaline and solonetz complexes
3	Izobilnensky	Water erosion	Rocky	Salinization	Deflation
4	Kochubeevsky	Salinization	Erosion + deflation	Alkaline and solonetz complexes	Rockiness
5	Krasnogvardeysky	Deflation	Salinization	Water erosion	Waterlogging
6	Novoaleksandrovsk	Water erosion	Waterlogging	Waterlogging	-
7	Trunovsky	Salinization	Water erosion	Rockiness	Waterlogging
8	Shpakovsky	Water erosion	Salinization	Alkaline and solonetz complexes	Deflation
agroclimatic zone III		Water erosion	Salinization	Deflation	Alkaline and solonetz complexes

A set of measures to preserve agricultural land should include measures aimed at combatting negative phenomena. Land monitoring in the zone of sufficient moisture is presented in Table 4. In the agroclimatic zone IV, there are the following negative phenomena: water erosion (176.8 thousand hectares), deflation (155.4 thousand hectares), salinization (78.9 thousand hectares) and rockiness (66.9 thousand hectares). Within three districts, overmoistening is a big problem. The matrix of main problems of land management is presented in Table 4.

Table 4: Matrix of main problems in agroclimatic zone 4.

No	District name	Main problems			
		1	2	3	4
1	Georgievsky	Deflation	Erosion + deflation	Alkaline and solonetz complexes	Salinization
2	Kirovsky	Deflation	Water erosion	Waterlogging	Salinization
3	Mineralovodsky	Water erosion	Salinization	Waterlogging	Alkaline and solonetz complexes
4	Predgorny	Water erosion	Rockiness	Waterlogging	Salinization
agroclimatic zone IV		Water erosion	Deflation	Salinization	Rockiness

5. Conclusion

The results of 60-year land monitoring indicates a complex environmental situation and aggravation of the problem of degradation of agricultural lands. The developed matrices of problems of agricultural land management are required for the development of comprehensive measures aimed at rectifying the current situation. Anti-erosion measures are the same, but they must have certain specific features reflecting particularities of a territory.

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