

# Complex reasons of decreases in fertility of Tomsk oblast soils

*E.A. Moliboga*<sup>1</sup>, *A.I. Syso*<sup>2</sup>, *N.A. Levochkina*<sup>3</sup>, *T.B. Smirnova*<sup>3</sup>, and *D.M. Fialkov*<sup>1</sup>

<sup>1</sup>Federal State Budgetary Educational Institution of Higher Education Omsk State Agrarian University, 644008 Omsk, Fizkulturnaya street, 8

<sup>2</sup> Soil Science and Agricultural Chemistry Institute Siberian branch of Russian Academy of Sciences, 113043 Moscow, Sistemnaya street, 12/3

<sup>3</sup> Department of industrial technologies, Siberian branch of K.G. Razumovsky Moscow State University of Technologies and Management (the First Cossack University), 644010 Omsk, Pushkina street

**Abstract.** Agricultural industry is the biggest intersectoral complex. The first priority of any country is to secure supply of abundant and safe food for the population. In 2017, Russian minister of agriculture A.N. Tkachev noted that Russia is able to feed itself and will be able to do so in the future as well. The task put forward by Vladimir Putin is to guarantee that at least 90% of food on market shelves is made domestically. This article examines specifics of land use in Tomsk oblast and fulfillment of governmental tasks.

## 1 Introduction

The main goals of Russian agrarian policy are: creation of food security, robust development of fertile territories, improvements in rural quality of life, increases in competitiveness of the agrarian sector, effective import substitution, increase in productivity of agricultural lands and other resources and creation of strong export-oriented agriculture capable of taking leading positions on the worldwide agricultural market [1,2,3,4]. These goals are expected to be achieved through international and regional integration as well as qualitative and scientific approach to global agricultural problems [5].

## 2 Contents

An important direction in the development of agriculture is substituting import with domestic products and not just switching exporting parties. It takes a considerable amount of time – not merely one or two years – to grow and expand domestic agriculture. It will not be able to quickly react to changes, even domestic, because of:

High dependence of several subsectors of agriculture on imported seeds, technologies, machinery, equipment etc. and inability to produce them domestically within short timeframes. This increases the amount of investments needed for import substitution.

Underdevelopment of cooperation and absence of major improvements in agricultural integration. In some countries (i.e. EU countries), cooperation and integration serve as a major developmental factor of agriculture. [4,5,6].

To meet food security goals and to develop agricultural capacities and processing industry, a corresponding federal program for years 2017-2025 was developed and approved [1,2,3,7]. The main and most interesting goal of the program is provision of stable increases of agricultural outputs realized through modern cultivation methods, using new variety of seeds etc. Completion of such tasks can be analyzed through yearly reports.

We have to note that solutions for agricultural improvement are correlated with decreases in soil fertility that is currently being managed mostly through fertilizer use. There are questions of soil fertility, solving which could considerably increase agricultural production and profitability.

For a detailed examination of the aforementioned correlation, it is necessary to consider another important detail – the possibility of soils to be employed in other sectors of the economy.

In this article, such an examination is based on Tomsk oblast data. Total area used for agriculture in Tomsk oblast is 1979,6 thousand hectares or 6,2% of total area of the region. (based on data from the federal registry [8]). Another important detail is an assessment of specific characteristics of Tomsk oblast, namely high amounts of swamps and forested terrain. Soils are also influenced by natural factors such as climate, flora, topography etc., as well as consequences of human activity that could result in both positive and negative impacts on soil quality.

It must be noted that, compared to 2018, total agricultural area in Tomsk oblast has shrunk from 2017,2 to 1979,6 thousand hectares, explained by their reclassification as forest reserves, industrial lands etc. A 2019 decrease in agricultural land area has become the most substantial for the past 10 years. Previously conducted analyses of agricultural registry [5,6,7] have shown the most dramatic decrease to happen in years 1990-1995. Total agricultural area has fallen from 3579,5 to 2752,5 thousand hectares, which is explained by socio-economic changes in the country, changes in ownership and legislation, and overall decreases in economic output. Some enterprises have been noted to give up on cultivating lands of low fertility that need fertilizing and melioration. Without resorting to such measures, it is unprofitable to develop low fertility lands, this fact is a major obstacle for stable growth of agricultural production.

Natural environment, soil characteristics, and previous usage of Tomsk oblast's soils created a specific structure of soil registry and classification. Total area of Tomsk soils is set at 1979,9 thousand hectares, that includes agricultural lands – 1240,9 thousand ha, swamplands – 345,9 and forestlands – 231,8 thousand ha.

If we review soils from an administrative perspective, we obtain the following conclusions:

- Northern lands - cold, humid and relatively remote – Aleksandrovsky, Kargasoksky and Verkhneketsky counties, which possess acidic and swampy podzol soils. Soil structure is characterized by low prevalence of arable lands, but a high percentage of pastures and hayfields.

- Southern, warmer and moderately humid lands of Parabelsky, Kolpashevsky, Bakcharsky and other counties. Such lands are characterized by decreases in pastures and hayfields and increases in arable land that reaches its maximum in Kozhevnikovsky, Shegarsky and Tomsky counties.

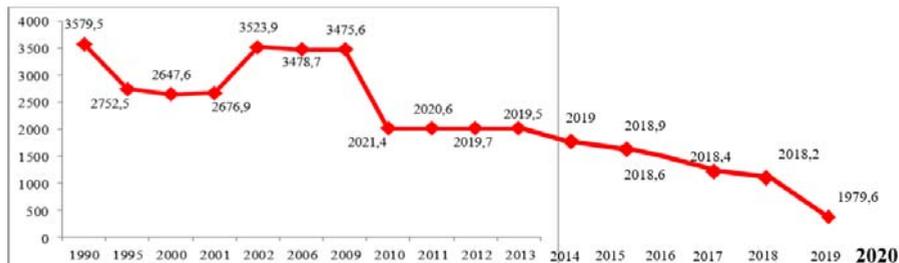
Analyzing agricultural statistics, we conclude that agricultural sector is in deep crisis. This is explained, in part, by hard socio-economic problems of rural areas and irrational use of agricultural land. Many developed countries attach specific importance to agricultural lands, this can be explained by views on food security – many countries see it as an

important and integral part of national security. Soil is a basic, yet unique production factor in agriculture. Agricultural lands have a special legal status, require constant maintenance and oversight, but sooner or later degrade anyway. Economic sanctions have shown what a poor state agriculture is in and this is a major problem for the government and the society at large to solve [9,10,11].

The change in structure of land classification and administration reflects wider, country-wide tendencies. Over the period of 29 years, total agricultural area was halved, yet overall industrial area has been increasing for the past 5 years, which is explained by growth in oil and gas industry. Over the past 30 years, agricultural lands of Tomsk oblast have shrunk considerably (Image 1).

Almost 30% of agricultural lands from 1990 to 2001 have been included into a restructuring fund since these lands weren't employed in production. They have subsequently been reclassified as land reserve and forest fund lands.

Shrinkage of agricultural lands direly affects fields and sowing areas. From 1990 to 2019, Tomsk oblast's field areas per capita have shrunk from 0,57 to 0,37 ha, which reflects the general tendency in Siberia. An analogous situation (shrinkage of fields) can be observed in some European countries.



**Fig. 1.** Changes in Tomsk oblast's agricultural lands 1990-2019

It is necessary to reflect on the main reasons of this drop:

- agricultural lands of Tomsk oblast are in low demand, which decreases the amount of land taxes for the budget. Low demand results in additional problems, mainly with soil integrity and composition – physical and chemical contamination, loss of fertility etc. Illegal mining of sand or illegal creation of landfills are also present. In 2019, Tomsk oblast contained 31 landfills with total area of 30,69 ha.

- continental climate of Tomsk oblast, characterized by big fluctuations in temperature.

- unauthorized mining of fertile topsoil also damages idle agricultural lands. Research shows that it takes one hundred years to form just one cubic centimeter of fertile topsoil in the Tomsk oblast area.

Removal of topsoil drastically decreases fertility levels, which have fallen by 1,5 times for the past 10 years.

All these damaging uses of agricultural lands cause ecological problems (e.g. contamination).

The analysis of both qualitative and quantitative land use reaches its conclusion: unused or misused agricultural lands in Tomsk oblast decrease land tax income and local production, damage local environment and demand considerable expenses on land restoration and melioration. [10,11,12].

Mentioning land fertility, it is important to remember a serious problem in modern agriculture, namely increases in soil density, which decreases plant size, crop yields and fertility itself. According to information from Federal Scientific Agricultural Engineering Center, increased density of soils affects more than 80% of land, which leads to losses of up to 30% of crop yields and producers' income. Annual yield losses amount to approximately

30 million tons, fuel overuse – up to 3 million tons. Modern multi-operational technologies in plant cultivation, using better and heavier equipment, increase soil density up to 98% after harvest. In order for plants to develop normally, a certain balance between solid particles, water and air is required in soil composition. An optimal soil contains approximately 50% of solids, 30% of water and 20% of air.

Further growth of crop cultivation productivity in Tomsk oblast is difficult without increases in soil fertility. Unfortunately, in recent years the problem has become more apparent. Agrochemical research has indicated that almost 1 ton of humus per hectare is lost annually on chernozemic soils. The main reason of fertility decline is erosion. 2214,9 thousand hectares of soils in Tomsk oblast are affected by water erosion, 279,4 thousand hectares – by wind erosion 192,1 – by combined water and wind erosion. Because of this, around 2 million hectares of land have low to very low phosphorus content. Around 600 thousand hectares contain low to very low amount of potassium. Agricultural research centers of Tomsk oblast have developed different methods of countering soil erosion, but because of various reasons, practical application of such methods is limited.

Another big problem of agriculture is an insufficient supply of organic and mineral fertilizers. It is widely known that without fertilizer use only 15-20% of main nutritional compounds returns to land after harvest. To preserve main nutritional compounds it is necessary to fertilize soils with at least 30 kg of mineral fertilizers per hectare. Unfortunately, in recent years, fertilizer use has decreased. In 1991, one hectare of land was fertilized with 900 kg of organic and 15,2 kg of mineral compounds. In 2012, it was 22,0 and 4,8 kg respectively. These data indicate that soil fertility in Tomsk oblast is in drastic decline, which makes adequate response measures necessary.

### **3 Conclusion**

Strategic goals in management and rational use of agricultural land in Tomsk oblast should be:

- rational planning of land usage;
- estimating land quality;
- controlling and protecting land use;
- land preservation and restoration;
- subsidizing agricultural sector;
- increases in use of idle land.

Agricultural lands cannot be indefinitely employed in economic sectors other than agriculture – it decreases food security of Tomsk oblast. A rational approach to land usage, based on economic and environmental efficiency, is needed.

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