Natural Resource Management, GIS & Remote Sensing
Volume 2, Number 1, 1-8
April 2020
DOI: 10.22121/ngis.2020.201352.1008

Geoecological assessment of the environmental impact of the Kuchino MSW landfill in the Balashikha district of the Moscow region

Konova Elizaveta✉

MSc student of State University of Land Use Planning, Moscow, Russia

✉ lizaveta2897@mail.ru

(Received: September 12, 2019/ Accepted: January 15, 2020)

Abstract In the process of economic and other activities of enterprises, waste is generated, the disposal of which currently causes a number of difficulties. There are places for disposal, neutralization or burial of waste (landfills), which occupy large areas and require close attention and regular monitoring, since the natural processes taking place on them have a negative impact on the environment.

The article presents the results of a study of the environmental impact of the Kuchino solid waste landfill (hereinafter referred to as MSW) in the Balashikha district of the Moscow Region in 2017. The components of the natural environment — soil cover, atmospheric air, and surface water — are analyzed. The current geoecological state of the landfill territory is determined. A point-rating map of the landfill resolution is compiled, where the impact zones are estimated, estimated at 1-5 points. Measures are proposed to prevent, minimize the negative impact of the landfill on the environment.

Keywords : landfill, impact, reclamation, environment, landfill gas.

1.Introduction

The MSW landfill is an engineering structure whose purpose is the reception, disposal and disposal of waste from consumption and production.

The negative environmental impact of any landfill, including the Kuchino landfill, is based on two main factors:

- landfill gas - gas that occurs during anaerobic decomposition of waste in the landfill body (in the process of waste accumulation in the landfill's body, natural decomposition begins without decomposition of oxygen with the release of carbon dioxide and methane);
- filtrate - wastewater generated as a result of seepage of atmospheric precipitation into the body of the landfill and the concentration given in its base. The filtrate is a liquid with a pungent odor of biogas.

he most common way to destroy solid waste is landfill, which is accompanied by a number of problems, namely:

1) Too fast overflow of landfill areas due to the huge amount of garbage. Without preliminary compaction, the average density of solid waste is 200-220 kg / m^3, which reaches only 450-500 kg / m^3 after compaction using garbage trucks [2].

To solve this problem, an increase in the number of solid waste landfills or the construction of waste recycling plants that will unload the work of landfills and ensure resource conservation (obtaining the necessary materials from recycled materials).

2)Non-compliance with the spatio-temporal use of the landfill. Design operation of landfills is 15-20 years. However, most polygons last much longer. They already adversely affect the environment, and after their use the environment (OS) should be restored. Due to the first problem (overflow), the landfills are expanded for further use, and as a result they "live" longer than their term.

3) Based on the first and second environmental problems, another very important problem follows - non-compliance with the sanitary protection zone (CVD) due to the expansion of the landfill area. When designing a landfill in a certain area, individual boundaries of the GCC are set, in addition to the generally accepted one - 500 m.However, with an excess of waste, overflow of the landfill, the GCC expands and disrupts it, as a result, all OS components suffer.

4) Negative factors for environmental impacts - contamination of groundwater with leachable products, unpleasant odor, waste dispersal by the wind, spontaneous ignition of landfills, uncontrolled formation of methane and an unaesthetic appearance are only part of the problem that worries ecologists and causes serious objections from local authorities. To solve this problem, cleaning measures, fencing and other similar actions on the part of the landfill workers are necessary. Also, to ensure the prevention of fire hazard, steps are needed to moisten the solid waste both at the storage stage and already compacted layers.

5) Lack of space suitable for placement of landfills at a convenient distance from large cities. The expansion of cities crowds out landfills to an ever greater distance. This factor, combined with rising land prices, increases the cost of transporting solid waste.

6) The inability to eliminate polygons. Despite using the best available technology, society will always need to use it to destroy non-processable fractions.

2.Research methodology

The research materials were used in the article - components of the natural and technogenic environment of the territory adjacent to the Kuchino MSW landfill - surface water, reservoirs with filtrate of the MSW landfill, atmospheric air, soil cover.

The Kuchino solid waste landfill can be considered as a point source of pollution. Therefore, to analyze and evaluate the impact of the landfill on the components of the OS, samples were taken in the territory of the landfill and beyond.

The research methods used in the work: theoretical method - analysis and synthesis; empirical methods - observation, comparison; cartographic method (creating map schemes in ESRI ArcGIS program).

To construct the map, the Kriging algorithm was used, based on the statistical characteristics of the input data, such as the average value. The map is compiled on the basis of water pollution indices (WPI), calculated by indicators: pH, COD, NH4, Cl, SO4, Fe in surface waters according to the Order "On approval of water quality standards for water bodies of fishery value, including standards for maximum permissible concentrations of harmful substances in the waters of water bodies of fishery importance "[1] and" Methodological recommendations for a formalized integrated assessment of the quality of surface and sea waters by hydrochemical indicators "[6]; soil pollution indices (total soil pollution index) (Zc) - Cd, Hg, Pb, Zn, Cu, Ni, V (SP 11-102-97) [4]; indices of atmospheric air pollution (ISA) - CH_4, H_2S, NH_3, NO_2, CO, C_6H_6 (RD 52.04.667-2005) [5].

The Kuchino MSW landfill is located in the urban district of Balashikha in the European part of the Russian Federation. The Pekhorka and Gorenka rivers flow through the territory of the okrug (fig. 1).

The landfill began operating in 1964, and it worked for about 53 years before closing for restoration - June 23, 2017.

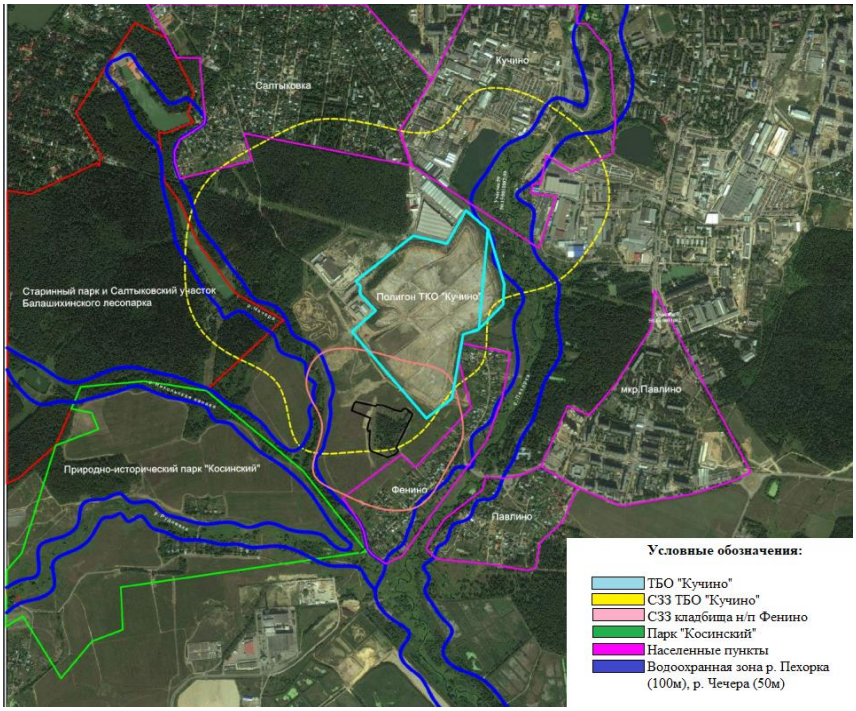

Figure 1 - Sanitary protection zones in the area of the Kuchino MSW landfill [9]

The OS assessment is based on a comparison of its state with established standards. The criteria are indicators of the natural state of nature and its background parameters.

To assess the ecological state of surface water, soil cover and atmospheric air under the influence of a landfill, a score-rating map based on the data obtained during the testing

was constructed using the Natural Neighbor algorithm in the ESRI ArcGIS program using the Natural Neighbor algorithm (fig. 2).

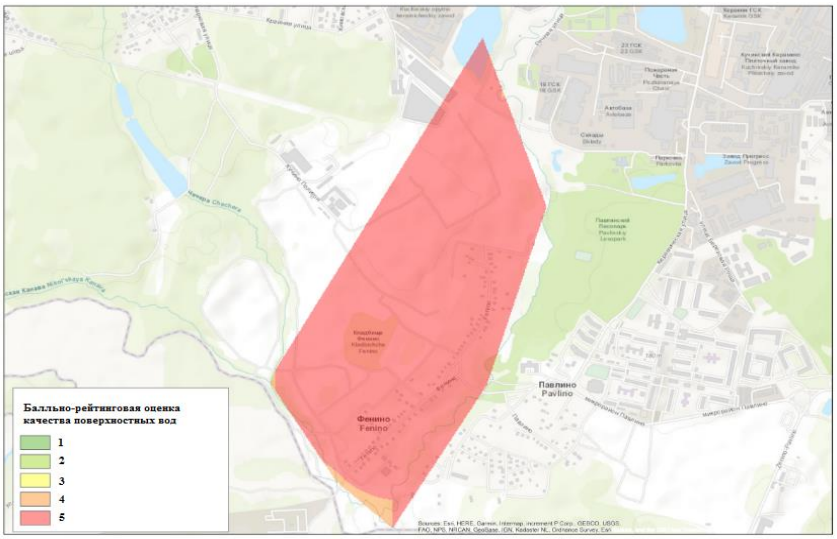

Figure 2 - Chart of point-rating assessment of surface water quality

The ecological state of surface water in the area of the Kuchino MSW landfill is estimated at 5 points, very dirty, with the exception of the southwestern part of the study area (4 points, fig. 3).

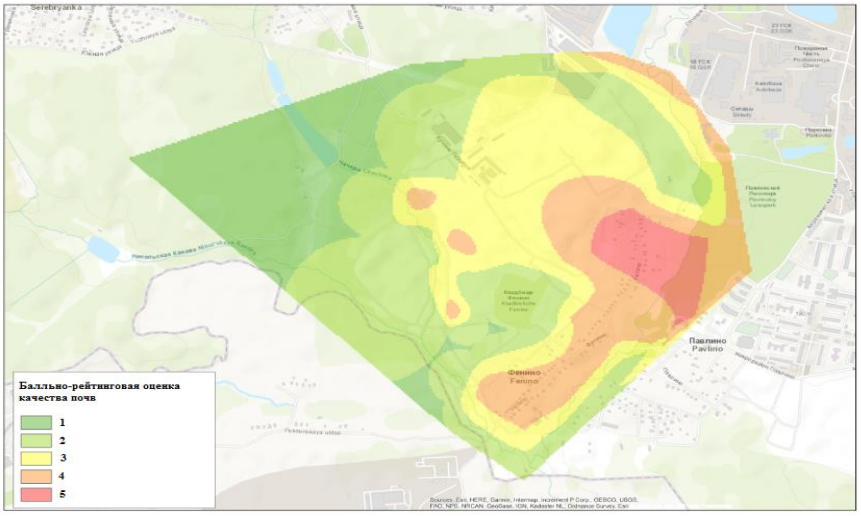

Figure 3 - Map of point-raging assessment of the quality of soil cover

Analysis of soil pollution in the influence zone of the Kuchino MSW landfill with heavy metals showed that 50% of the surveyed sites are characterized by an acceptable level of total accumulation (1 point), a moderately hazardous category is noted at 8% of the tested sites, and a dangerous category at 38%. An extremely dangerous category of complex pollution of soils with heavy metals is noted in the southeastern part of the landfill.

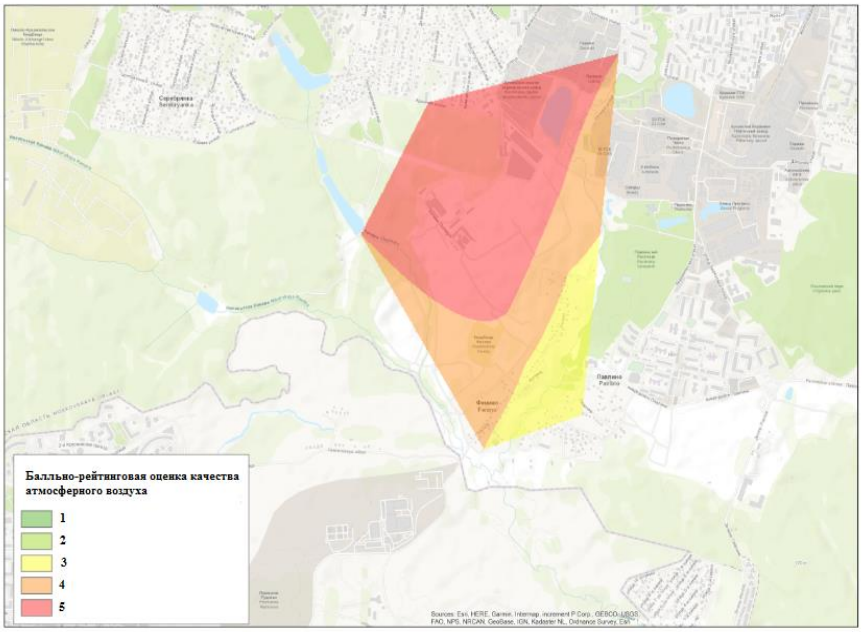

Figure 4 - Point-rating assessment of atmospheric air quality

From figure No. 4 it follows that the greatest pollution is noted from the northern to the central part of the landfill (5 points). To the south, the concentration of pollutants is dispersed. This is because the prevailing wind in the summer (samples were taken in June 2017) - northern, northwest, southwest - pollution is already estimated not at 5 points, but at 2 and 3 points.

3.Results and Evaluation

A geoecological assessment of the impact of the Kuchino MSW landfill on the state of the OS according to the research results showed that the components - atmospheric air, soil cover and surface water are contaminated unevenly.

Based on the data obtained, the calculations performed and the constructed map diagrams, a comprehensive map diagram was developed for assessing the impact of the landfill on the OS in the ESRI ArcGIS program using the Kriging algorithm.

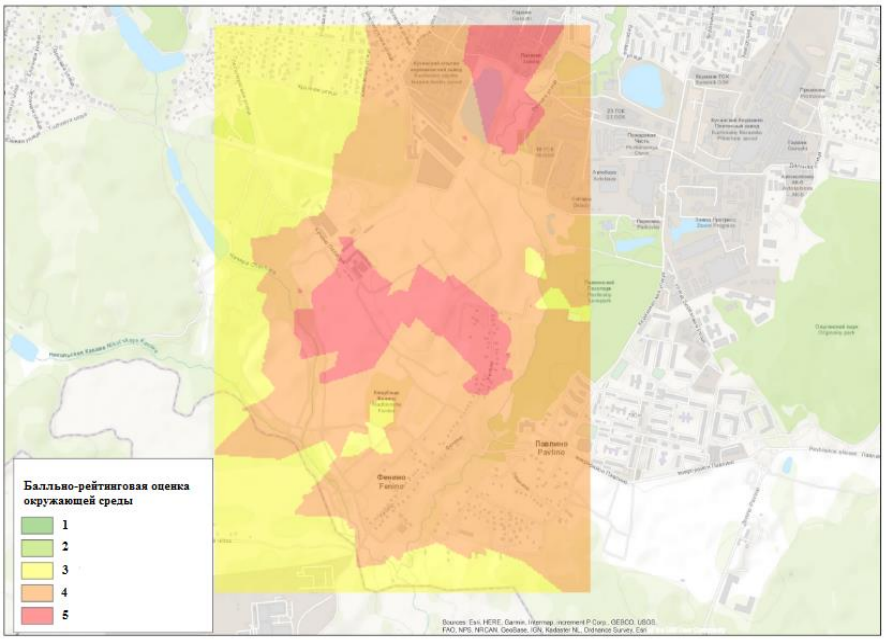

Figure 5 - Point-rating assessment of the state of the environment

Figure 5 shows two noticeable foci of pollution estimated at 5 points (extremely dangerous): the central part of the Kuchino MSW landfill and north of the landfill in the microdistrict. South Kuchino.

Analysis of the soil cover located in the zone of potential impact of the Kuchino MSW landfill revealed that, in general, their general ecological and geochemical state is characterized as satisfactory.

Summing up the data of a comprehensive study, we can conclude that in the soils of the zone of influence of the Kuchino MSW landfill, a significant change in environmental and geochemical parameters (heavy metals) is detected.

Since the decisions on remediation adopted an environmental and sanitary-hygienic direction with the prospect of development in the territory of the recreation zone, i.e. If there is no agricultural use of land in the zone of influence of the landfill, the nearest territories to which SanPiN 2.1.7.1287-03 requirements may apply are: n / a Fenino, md. Pavlino and Saltykovka, South Kuchino [3].

Within the above mentioned settlements, complex chemical pollution varies from dangerous to extremely dangerous (the last category of land is found in the n / a Fenino and the southern border of the micro district. Southern Kuchino).

In the area of microdistrict. South Kuchino, in the industrial zone there is a reservoir, which was investigated in assessing the ecological state of surface waters. An old landfill is located between the landfill and this pond. The western shore of the reservoir is littered with construction waste, some of them in the water. All this indicates pollution as a reservoir, there and the surrounding area.

In general, the assessment of the ecological state of the environment in the Kuchino municipal solid waste area is characterized as dangerous, a score of 4 is assigned.

4.Conclusion

Since June 23, 2017, the Kuchino MSW landfill has not been functioning as a waste disposal facility; the landfill has been officially closed. Reception and disposal of waste on the territory of the Kuchino landfill is not carried out.

Given the current environmental situation in the area of the Kuchino MSW landfill, the operational development of a set of environmental measures is necessary, namely:

• reduction of air pollution;
• reduction of surface and groundwater pollution;
• reduction of soil pollution;
• use of an anti-filter screen on the landfill body;
• introduction of a system for collecting and utilizing biogas and filtrate;
• introduction of organizational measures to prevent unauthorized waste dumping at the landfill;
• gardening of the territory.

Minimizing the impact of accumulated environmental damage to the components of the environment caused by the Kuchino landfill by reclamation, which represents the collection and treatment of waste water (leachate) and collection, disposal (treatment) and biogas utilization, the results of all the work will be created park with an area of 130 ha [7.8].

The intended activity in terms of content is a set of measures related to the elimination of accumulated damage to natural complexes in connection with a violation of environmental laws when handling waste.

Violation of waste disposal technology at the Kuchino landfill in question led to an emergency and a negative impact on the environment and human health.

Reclamation measures of the Kuchino MSW landfill are:

- relief formation (terrace);
- installation of an anti-filter screen;
- application of soil;
- device of radiation drainage;
- active degassing system (flare thermoelectric power station);
- gardening of the territory.

Based on these remediation measures, the following tasks will be solved:

1. Reducing the influx of pollutants generated as a result of biological degradation of waste by installing an active biogas degassing system with flow output to a thermal decontamination system - a high-temperature flare unit.
2. Reducing the volume of contaminated effluent in the form of leachate into the soil by means of a beam drainage system with the collection of leachate and its discharge to treatment facilities.
3. The gradual reduction in the formation of leachate in the body of the landfill after the implementation of the anti-filter screen on the body of the landfill;

4. The restoration of biological diversity in the area of reclamation after the completion of the technical and biological stages of landfill reclamation.

Reference

1. Order of December 13, 2016 N 552 “On approval of water quality standards for water bodies of fishery importance, including standards of maximum permissible concentrations of harmful substances in the waters of water bodies of fishery value” (as amended on October 12, 2018) / [Electronic resource]/
2. SanPiN 2.1.7.722-98 Hygienic requirements for the design and maintenance of landfills for solid household appliances / [Electronic resource] /
3. SanPiN 2.17.1287-03 "Sanitary and epidemiological requirements for soil quality" / [Electronic resource] /
4. SP 11-102-97 Environmental engineering surveys for construction / [Electronic resource] /
5. RD 52.04.667-2005 Documents on the state of air pollution in cities for informing state bodies, the public and the public. General requirements for the development, construction, presentation and content / [Electronic resource] /
6. RD 52.24.643-2002. Guidance document. Methodical instructions. A method for a comprehensive assessment of the degree of pollution of surface waters by hydrochemical indicators / [Electronic resource] /
7. Balashikha urban district http://balashiha.ru/press_center/news/istoriya-krasnoy-knigi/
8. The project of reclamation of the landfill “Kuchino” in the territory of the urban district of Balashikha, Moscow region Design documentation. 293 p.
9. The project of reclamation of the landfill “Kuchino” in the territory of the urban district of Balashikha, Moscow region (Appendix). 194 c.tourism. Quaestiones Geographicae 31(1):99–107.