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THE ECOLOGICAL STATE OF RURAL RESIDENTIAL AREAS OF KYIV REGION IN THE INTENSIVE LIVESTOCK FARMING ZONE

Pinchuk V.O. – PhD, Senior Researcher,

Laboratory of Agrobiological Resources Monitoring

Palapa N.V. – DAgrSc, Head of the Rural Development Sector

Tertychna O.V. – Dr.Sc. (Biology), Senior Researcher,

Laboratory of Soil Rehabilitation and Organic Production

Kotsovska K.V. – PhD,

Head of the Laboratory of Agrobiological Resources Monitoring

Mineralov O.I. – Researcher,

Laboratory of Agrobiological Resources Monitoring, Institute of Agroecology and

Environmental Management of NAAS

The ecological state of atmospheric air, soil and water of rural residential areas in the intensive livestock zone is estimated. The excessive MPC in the air was detected by the average daily content of nitrogen dioxide (NO_2) in the Dymer village in 1,6 times and hydrogen sulfide (H_2S) in three human settlements: Gavrylivka – in 1,25 times, Gostomel – in 2,5 and Dymer – in 1,25 times. Also, excessive MPC in water was detected for nitrate content in the Rykun village in 3,5 times and the Tarasivschina village in 5,8 times. In human settlements Tarasivschina and Sinyak found non-compliance of water wells of households with the State sanitary norms and regulations 2.2.4-171-10 on the contents of *E. coli*. It is found that the key reasons of environment contamination involve the next one: non-compliance with the requirements of the State Building Codes B.2.2-12-12:2018 of the population, eutrophication processes of surface water bodies, industrial emissions, and excessive poultry manure application into the soil of households from poultry farms.

Key words: environmental state, residential areas, environmental pollution, livestock, emissions, sanitary-microbiological analysis.

Пінчук В.О., Палапа Н.В., Тертична О.В., Коцовська К.В., Мінералов О.І. Екологічний стан сільських селітебних територій Київської області у зоні інтенсивного тваринництва

Оцінено екологічний стан атмосферного повітря, ґрунту і води сільських селітебних територій у зоні інтенсивного тваринництва. Виявлено перевищення ГДК в атмосферному повітрі за середньодобовим вмістом діоксиду азоту (NO_2) в с. Димер в 1,6 разів та сірководню (H_2S) в 3-х населених пунктах: Гаврилівка – в 1,25, Гостомель – в 2,5 і Димер – в 1,25 разів. Також виявлено перевищення ГДК у воді за вмістом нітратів в с. Рикунь – в 3,5 і с. Тарасівщина – в 5,8 разів. У населених пунктах Тарасівщина і Синяк виявлено невідповідність води колодязів домогосподарств нормам ДСанПіН 2.2.4-171-10 за вмістом *E. coli*.

Встановлено, що основними причинами забруднення навколишнього природного середовища є не дотримання населенням вимог Державних будівельних норм, процеси евтрофікації наземних водних об'єктів, промислові викиди і надмірне внесення посліду з птахокомплексу у ґрунт домогосподарств.

Ключові слова: екологічний стан, селітебні території, забруднення довкілля, тваринництво, викиди, санітарно-мікробіологічний аналіз.

Пинчук В.А., Палапа Н.В., Тертичная А.В., Коцовская К.В., Минералов О.И. Экологическое состояние сельских селитебных территорий Киевской области в зоне интенсивного животноводства

Оценено экологическое состояние атмосферного воздуха, почвы и воды сельских селитебных территорий в зоне интенсивного животноводства. Обнаружено превышение ПДК в атмосферном воздухе по среднесуточному содержанию диоксида азота (NO_2) в с. Дымер в 1,6 раза и сероводорода (H_2S) в 3-х населенных пунктах: Гавриловка – в 1,25 раза,

Гостомель – в 2,5 и Дымер – в 1,25 раза. Также обнаружено превышение ПДК в воде по содержанию нитратов в с. Рыкунь – в 3,5 раз и с. Тарасовщина – в 5,8 раз. В населенных пунктах Тарасовщина и Синяк выявлено несоответствие воды колодцев домохозяйств нормам ГСанПиН 2.2.4-171-10 по содержанию E. coli.

Установлено, что основными причинами загрязнения окружающей среды является не соблюдение населением требований ДБН Б.2.2-12:2018, процессы эвтрофикации наземных водных объектов, промышленные выбросы и чрезмерное внесение помета с птицекомплекса в почву домохозяйств.

Ключевые слова: экологическое состояние, селитебные территории, загрязнение окружающей среды, животноводство, выбросы, санитарно-микробиологический анализ.

Introduction. Intensive livestock systems in Ukraine are characterized by the use of significant land resources, high density of livestock per unit area of agricultural land – up to tens of thousands of heads per 100 hectares, consumption of a significant amount of natural resources and manure production and emissions [1, p. 132]. Livestock farms can produce more waste than can be utilized locally, which poses serious risks for environmental pollution and human health in adjoining residential areas.

To the negative ecological consequences of intensive livestock farming in Ukraine may be included the following: contamination of surface water bodies, soils and groundwater by production wastes; the formation of significant volumes of sewage waters, that are saturated with xenobiotics; atmospheric air pollution by harmful gases and dust emissions; microbiological contamination of soil and air; distribution of ectoparasites [2; 3, p. 51; 4].

The reasons of the negative ecological state of rural residential areas in the intensive livestock farming zone may be the violation of technologies of waste management and non-rational use of manure nutrients by large livestock enterprises and non-compliance with the requirements of the State Building Codes of people's households.

Since more than 60% of agricultural products are produced on the Ukrainian market by private farms, the environmental status of these territories should be monitored at the national level [5, p. 89].

Given the above, it is necessary to monitor residential areas, especially those not previously investigated, for example in the area of intensive livestock.

Materials and methods. The research was carried out on the rural residential areas of 10 human settlements of Vyshgorod district in Kyiv region, namely, Voronkivka, Dymer, Demydiv, Gostomel, Gavrylivka, Lytvynivka, Rakivka, Rykun, Synyak and Tarasivshchyna, which are situated near the large poultry farm complex LTD “Complex Agromars” that is located in Gavrylivka village.

Measurements of atmospheric air composition conducted by using the gas analyzer for human settlements investigation: 604-342EX07-02 (NH₃); 604-666EX17-02 (H₂S); 604-645EX03-02 (NO₂); 604-667EX05-02 (SO₂). The measurements made on October 18–19 and November 2, 2018, under the following meteorological conditions: clear weather, no wind, air temperature 16–18°C, humidity of air was 50–60%.

In order to carry out an analysis, samples of water and soil selected in accordance with the acting State Standard of Ukraine (hereafter DSTU): DSTU 4287:2004, DSTU ISO 10381-6-2001, DSTU ISO 5667-11:2005, DSTU 4808:2007, ISO 19458:2006.

The chemical analysis of iron, nitrates and ammoniacal nitrogen content in water samples, and sanitary and microbiological analysis of water and soil was conducted by the Vyshgorod Interdistrict Laboratory Researches Department of the State Institution “Kyiv Regional Laboratory Center of the Ministry of Health of Ukraine”.

The value of the maximum permissible concentration (MPC) of harmful substances in the atmosphere of human settlements determined according to the “State sanitary rules for the atmosphere air protection of residential areas (from chemical and biological substances contamination)”.

The ecological condition of well water (content of Fe, NH₄, NO₃ and *E. coli*) was evaluated according to the requirements of the State sanitary norms and regulations 2.2.4-171-10 “Hygienic requirements for drinking water intended for human consumption”.

The sanitary-microbiological state of the soil estimated according to the generally accepted methodological recommendations [6, 7].

The indices of atmospheric pollution were determined as the ratio of the average daily levels of NO₂, SO₂, H₂S and NH₃ in the air to their MPC, expressed in relative units.

Results and discussion. According to the data of the State Statistics Service of Ukraine, in all types of households of Kyiv region, concentrated 3,5% of cattle, 8,1% of pigs and 14,4% of poultry of the total number of agricultural livestock in Ukraine. Therefore, Kyiv region takes the 1st place according to the pig stock among other regions and takes the 2nd place according to the number of poultry, respectively, and by the level of anthropogenic impact on the environment from livestock waste products. A considerable proportion of livestock is concentrated in the people’s households – on average of 52,7% in Ukraine and 25,2% in Kyiv region (Table 1).

Table 1

The number of different species of agricultural livestock in people’s households of Kyiv region as of January 1, 2018 (the State Statistics Service of Ukraine) [8]

Animal species	Total agricultural livestock in Ukraine	Agricultural livestock in Kyiv region, ths. heads	
		Total livestock of all households types	Livestock in people’s households
Cattle, ths. heads	3 530,8	121,9	36,9
Pigs, ths. heads	6 109,9	496,1	95,8
Poultry, mln heads	20 4830,9	29508,6	7628,6

The analysis of air pollution level was conducted in the following settlements: Dymer, Gavrylivka, Gostomel, Tarasivshchyna, and Rykun. The excessive MPC in the air was detected by the average daily content of nitrogen dioxide (NO₂) in the Dymer village in 1,6 times and hydrogen sulfide (H₂S) in three human settlements: Gavrylivka – in 1,25 times, Gostomel – in 2,5 and Dymer – in 1,25 times (Table 2).

Table 2

Indices of atmospheric pollution (IAP) by average daily level in the human settlements of Vyshgorod district of Kyiv region

Human settlements	NO ₂ , mg/m ³	IAP, rel. u	SO ₂ , mg/m ³	IAP, rel. u	H ₂ S, mg/m ³	IAP, rel. u	NH ₃ , mg/m ³	IAP, rel. u
Gostomel	0,03	0,8	0,03	0,6	0,02	2,5	0,02	0,5
Gavrylivka	0,03	0,8	0,02	0,4	0,01	1,25	0	0
Tarasivshchyna	0,04	1,0	0	0	0	0	0	0
Dymer	0,06	1,6	0,03	0,6	0,01	1,25	0	0

A slight excess of the average daily MPC by NO_2 content in the air is directly connected with emissions from industrial enterprises, automobile transportation, heat and power plants, housing and communal services. The reasons for high H_2S content in the air may be detected in the human settlements, swamps, enriched ponds, and the river Kizka.

By conducting the sanitary-microbiological analysis of soil of private plots in the human settlements of Dymer, Gavrylivka, Demydiv, Rakivka, Tarasivshchyna Voronkivka, Rykun and Dymer, the pathogenic microflora was not revealed.

According to the requirements of the State Building Codes B.2.2-12-12:2018, household outbuildings (sheds for cattle, poultry, and other animals), batch composting grounds, toilet accommodations, garbage cans, special storages for fertilizer and toxic chemicals should be located at least 20 m from the well. In the case where these standards are not maintained, all household outbuildings and surrounding sites is a potential source of pollution and deterioration of physical and chemical, as well as sanitary and biological indicators of drinking water quality. The majority of the population does not even know and accordingly does not follow the State building regulations of planning and development of territories.

It is found that drinking water by Fe and NH_4 content from the water supply of households in Gavrilovka village not exceed MPC (Fig. 1).

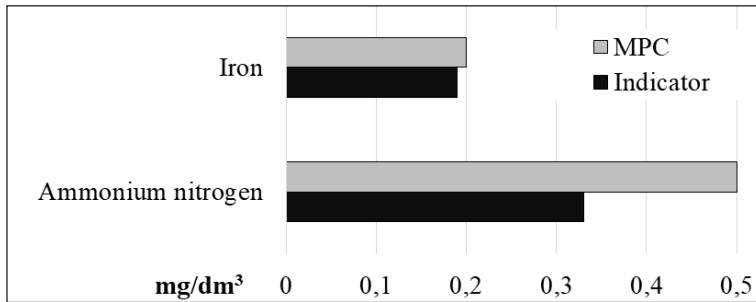


Fig. 1. The analysis of drinking water by Fe and NH_4 content from the water supply of households in Gavrylivka village of Vyshgorod district of Kyiv region

Most of the investigated households raise livestock and grow the crop on the private agricultural plots. Poultry dung and manure are used as fertilizers and in unreasonably high doses are applied into the soil. The residents buy poultry dung in the company LTD “Complex Agromars”. The content of toilet accommodations is also thrown into the gardens and dig into the soil.

The wells of households are not deep (4–15 m) and the predominant soils of private agricultural lands have light granulometric composition, which does not delay the products of life products of vital functions of people and animals, resulting in pollution of water of wells by nitrates because of their high migration capacity in the soil (Fig. 2).

Waste from the Canalizations are pumped out and removed to specialized places, nobody does not clean and disinfect the wells.

Table 3 shows the sanitary-microbiological studies of the water of tubular and mine wells of households.

It was established that the content of *E. coli*, water from the 2 shaft wells are non-compliance with requirements of the State sanitary norms and regulations 2.2.4-171-10. The reason for water pollution is the violation of the norms State Building Codes B.2.2-12-12:2018 and V.2.5-75:2013 regarding the distance between the farm buildings, the sewage system and the well.

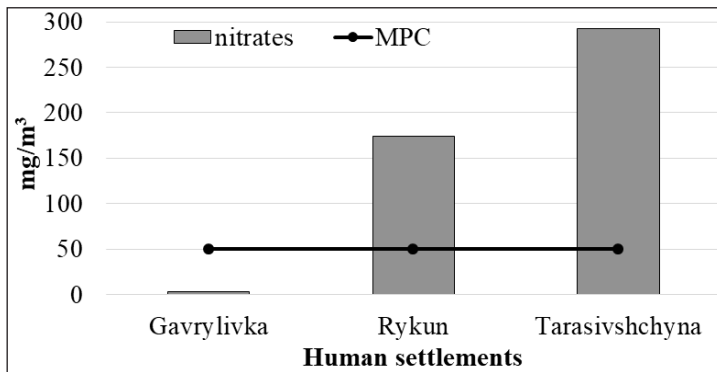


Fig. 2. The analysis of drinking water by nitrate content from tubular and shaft wells of households of human settlements of Vyshgorod district of Kyiv region

Table 3

The sanitary-microbiological analysis of water of tubular and shaft wells of households

Human settlements	Type of well	Total coliforms	<i>E. coli</i> in 100 sm ³	Compliance with the State sanitary norms and regulations 2.2.4-171-10
Tarasivshchyna	shaft	>1	available	Non-compliance
Synyak	shaft	>1	available	Non-compliance
Demydiv	tubular	<1	non-available	compliance
Rakivka	tubular	<1	non-available	compliance
Voronkivka	tubular	<1	non-available	compliance
Lytvynivka	tubular	<1	non-available	compliance
Gavrylivka	tubular	<1	non-available	compliance
Rykun	shaft	<1	non-available	compliance
Dymer	tubular	<1	non-available	compliance

Conclusions. It was determined, that the main reasons of environmental contamination of the territory of investigated rural residential areas are non-compliance with requirements of the State Building Codes, the eutrophication processes of surface water bodies, industrial emissions and excessive application of poultry dung into the soil of household plots. In particular, excessive MPC in the atmosphere was detected by the average daily content of nitrogen dioxide and hydrogen sulfide, in water – by nitrates and *E. coli* content.

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