Environmental impact of nitrogen loss from agriculture: Case study of selected farms characterized by various types of animal production

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Abstract: The loss of different forms of nitrogen (nitrate NO_3^-, ammonia NH_3, and nitrous oxide N_2O) from farming systems poses a threat to biodiversity, climate, and human health. In Poland, we can observe a large problem of environmental pollution caused by nitrates connected with irrational use of natural fertilizers in agriculture. This is especially reflected in the level of pollution of the Baltic Sea. In recent years, it has turned into an entropic sea with dead water zones. For this state of affairs, Polish agriculture is responsible for 60%, more precisely discharge through rivers of biogenic compounds from agriculture, including nitrogen. The main aim of the study is to assess the impact of nitrogen compounds caused by agricultural activity from selected farms situated in south-western Poland. Based on the examples of selected farms specializing in different types of animal production, the quantities of natural fertilizers produced were determined, followed by the size of nitrogen loads associated with them. The amount of nitrogen produced from natural fertilizers is closely related with the type of animal production. A cattle produces much larger amounts of manure compared to pigs. In the further part of the analyzes, the obtained results were referred to the area of the acreage. It was found that, it is possible to use all of the natural fertilizers produced to fertilize own fields. In none of the analyzed farms this will result in exceeding 170 kg of nitrogen in the pure ingredient per ha.

INTRODUCTION

Different forms of nitrogen: nitrate NO_3^-, ammonia NH_3, and nitrous oxide N_2O from farming systems pose influence on environment, climate, and human health [1,4,5,8-10]. One of the most serious problems related to the emission of nitrogenous compounds is the problem of deteriorating water quality. Excess of nitrates in the natural environment leads, among others, to the eutrophication of surface waters and permanent pollution of groundwater.

In Poland, we can observe a large problem of environmental pollution caused by nitrates connected with irrational use of natural fertilizers in agriculture. This is especially reflected in the level of pollution of the Baltic Sea. In recent years, it has turned into an entropic sea with dead water zones. For this state of affairs, Polish agriculture is responsible for 60%, more precisely discharge through rivers of biogenic compounds from agriculture, including nitrogen [4,7,8,10-12]. The protection of surface water requires searching for ways to slow down, inhibit or even reverse eutrophication or remove its negative consequences, mainly by limiting the flow from the basin of nutrients and organic matter. Meanwhile, according to Benoit [6,7] from approx. 5 tons of fertilizers per year from an area of 1 hectare approx. 1,000 kg of nitrogen penetrates the ground. Importantly, nitrate ion in the soil is not subject to exchangeable sorption, so it is susceptible to washing out into the soil profile, from where it goes to groundwater, causing a threat to the reservoirs of

drinking water. Indicating this threat, the World Health Organization (WHO) recommends as a safe, maximum permissible level of nitrate concentration in drinking water as 10 $mg \cdot dm^{-3}$. Unfortunately, this level is difficult to maintain in some agricultural regions [9]. It is therefore necessary to monitor the potential threat to the cleanliness of water coming from agricultural activity. First of all, dislocation and the size of sources should be determined, and then their impact on the fertilized surface and the size of its unit load should be determined. Such an attempt was made by the authors of this study, who for 4 selected farms estimated the amount of nitrogen load introduced into the environment during the use of natural fertilizers derived from animal production.

MATERIALS AND METHODS

Four farms located in the south-western part of Poland were selected for analysis. Selected farms differed in size (area of farmland in ha) and type of livestock production. To better illustrate the amount of nitrogen produced depending on the animal species, age and productivity, two large farms were compared together, one specializing in cattle breeding (farm No. 2), second specializing in - swine production (farm No. 1). In addition, the calculations were carried out for farms with mixed animal production: one medium (farm No. 3) and one small (farm No. 4) – where traditional methods of farming are used. Data for analyzes were obtained using the direct interview method. On the basis of the obtained data, the average annual production volumes of natural fertilizers and concentrations of nitrogen contained in them were calculated, taking into account the species of animals being bred, their age and the system of farming. The calculations were based on the methodology set out in the Regulation of the Council of Ministers of 5th June 2018 regarding the adoption of "Program of measures aiming to reduce water pollution with nitrates from agricultural sources and prevention of further pollution" [3], which is the most current implementation of the Nitrates Directive in Polish conditions.

RESULTS AND DISCUSSION

Description and analysis for the farm No. 1

Farm No. 1 is run in a mixed type (plant and animal production) and covers an area of 100 ha. The whole area of the farm is arable land. Class IV and V are the dominant class of soil. Soils classified as class III constitute only 15%. The sowing structure includes mainly grain and in 2018 it was as follows: wheat - 10 ha, winter barley – 10 ha, spring barley - 20ha, rape - 10 ha, rye - 20 ha, triticale - 15 ha, grain mixture - 10 ha and peas - 5 ha. The farm is producing swine in a three-week cycle. The livestock is as follows: boars - 2 pieces, sows - 60 pieces. The number of piglets in one litter is 11 on average, which gives about 1650 piglets per year. This number, reduced by 5% (demise), gives round of 1570 piglets per year. Piglets after 4 weeks are relocated to chambers, where they are kept without bed litter flooring (on grates). The farm has 3 chambers with dimensions 7.8 x 9m, which gives a total area of litter 210.6 m^2. The slurry is stored directly under the grates. The volume of the slurry tank

is 56.16 m^3. Weaners after reaching 30 kg are relocated to chambers adapted for deep bed litter breeding. They are kept like this to the moment when they reach the appropriate weight required for sale. The farm has 10 such deep bed litter flooring chambers. From 35 to 40 fatlings can be kept in one of them. The time from birth to sale, in which the animal stays on the farm is half a year (2 months - as a piglet, 2 months - a weaner, 2 months - a fatling). There is a manure pad outside of the building with an area of 240m^2. Under the manure pad, there is a liquid manure tank (cesspool) - 3x2, 5x18m. The volume of the tank is 135 m^3. Natural fertilizers are exported three times a year (in spring, in summer after harvesting and in autumn before plowing of agricultural land for the winter). The farm has its own equipment for the export of natural fertilizers, i.e. a slurry tanker. Average annual production volumes of natural fertilizers (manure, liquid manure, slurry) on farm No. 1 are presented in Table 1.

Table 1. Average annual production volumes of natural fertilizers on the farm No. 1

Species/ technological group of animals	**The number of animals bred during the year**	**Maintenance system**				**Average annual production of natural fertilizers Mg or m^3**
		Deep bed litter flooring	**Shallow bed litter flooring**		**Without bed flooring**	
		manure	**manure**	**liquid manure**	**slurry**	
		Production (Mg/a) from 1 piece	**Production (Mg/a) from 1 piece**	**Production (Mg/a) from 1 piece**	**Production (Mg/a) from 1 piece**	
Knout	2	-	3.2	1.9	-	6.4 Mg of manure 3.8 m^3 of liquid manure
Sows	60	-	3.7	1.8	-	222 Mg of manure 108 m^3 of liquid manure
Piglets from 0-4 weeks	1570	-	0.3	0.2	-	39 Mg of manure 26 m^3 of liquid manure
Piglets from 4 weeks to 2 months	1570	-	-	-	0.7	92 m^3 of liquid manure
Weaner from 2 to 4 months	1570	-	-	-	1.4	366 m^3 of liquid manure
Fatling from 4 to 6 months	1570	2.0	-	-	-	523 m^3 of liquid manure

The farm produces more than 276 Mg of manure and almost 1,119 m^3 of liquid manure. Most of all processes, keeping sows generate the largest amount of manure. In turn, the most liquid manure is produced during fatling production. The obtained results to pure nitrogen concentration have been converted. The results are presented in the Table 2.

Table 2. Concentration of nitrogen in natural fertilizers produced on the farm No. 1

Species / technological group of animals	Average annual production of natural fertilizers	Maintenance system				The concentration of nitrogen in the pure component
		Deep bed litter flooring	Shallow bed litter flooring		Without bed litter flooring	
		manure	manure	liquid manure	slurry	
	Mg or m^3	Content (kgN/Mg)	Content (kgN/Mg)	Content (kgN/m^3)	Content (kgN/m^3)	kgN
Knout	6.4 Mg of manure 3.8 m^3 of liquid manure	-	3.1	3.3	-	19.8 kg N from manure; 12.5 kg N from liquid manure
Sows	222 Mg of manure 108 m^3 of liquid manure	-	4.0	4.2	-	888 kg N from manure; 453.6 kg N from liquid manure
Piglets from 0-4 weeks	39 Mg of manure 26 m^3 of liquid manure	-	0.9	0.4	-	35.1 kg N from manure; 9.6 kg N from liquid manure
Piglets from 4 weeks to 2 months	92 m^3 of liquid manure	-	-	-	2.0	184 kg N from liquid manure
Weaner from 2 to 4 months	366 m^3 of liquid manure	-	-	-	2.8	1,024.8 kg N from liquid manure
Fatling from 4 to 6 months	523 m^3 of liquid manure	4.2	-	-	-	2,196.6 kg N from manure

The total amount of pure nitrogen produced on farm No. 1 is about 4,824 kg.

Description and analysis for the farm No. 2

The farm No. 2 is involved in the breeding of dairy cows and beef cattle. It covers an area of 221 ha, of which 27 ha are permanent grassland, while the remaining 194 ha are arable lands, where, next to rape - 17 ha and maize - 41 ha, grains are cultivated for feeding purposes. Class II and III are the dominant class of soils. In 2018, cattle breeding was carried out in the following quantities: 70 dairy cows (with a capacity of more than 6 to 8 thousand liters), calves up to 6 months - 35 pieces, beef cattle from 6 months to a year - 68 pieces, beef cattle above 1 year - 126 pieces. Cows are kept without bedding litter, the cow beds are covered with sand. There is a slurry reservoir with the volume of 215 m^3. Calves up to 6 months and from 6 months to 1 year are kept in specially designed pens on shallow bed litter flooring. The manure is taken to a manure pad with an area of 190m^2. Slurry and manure are exported twice a year. Beef cattle for fattening from over 1 year, is bred in the pasture system. Cattle have at their disposal a covered shelter with an area of 220 m^2, where they have access to feed and water. The breeding takes place on the plots, on the area of 10 hectares of permanent grasslands. Therefore, the herd does not produce any manure nor liquid manure. The farm has modern cultivation equipment, as well as equipment facilitating work in the cowshed - feed wagons, manure scrapers.

The average annual production volumes of natural fertilizers (manure, liquid manure, slurry) on farm No. 2 are presented in Table 3. Table 4 presents data related to the calculation of these quantities into the form of pure nitrogen.

Table 3. Average annual production volumes of natural fertilizers on the farm No. 2

Species/ technological group of animals	The number of animals bred during the year	Maintenance system			Average annual production of natural fertilizers (Mg *or* m^3)
		Tile litter		Without tile litter	
		manure	liquid manure	slurry	
		Production (Mg/a) from 1 piece	Production (Mg/a) from 1 piece	Production (Mg/a) from 1 piece	
Dairy cows	70	-	-	23	1,610 m^3 of slurry
Calves up to 6 months	35	1.6	1.4	-	28 Mg of manure 24.5 m^3 of liquid manure
Cattle from 6 months to 1 year	68	5.0	3.8	-	170 Mg of manure 129.2 m^3 of liquid manure
Cattle over 1 year	126	Does not produce manure and liquid manure - a pasture system			

Table 4. Concentration of nitrogen in natural fertilizers produced on the farm No. 2

Species/ technological group of animals	Average annual production of natural fertilizers	Maintenance system			The concentration of nitrogen in the pure component
		Tile litter		Without tile litter	
		manure	liquid manure	slurry	
	Mg or m^3	Content (kgN/Mg)	Content (kgN/m^3)	Content (kgN/m^3)	kgN
Dairy cows	1,610 m^3 of slurry	-	-	4.0	6,440 kgN from slurry
Calves up to 6 months	28 Mg of manure 24.5 m^3 of liquid manure	2.8	2.3	-	78.4 kg N from manure; 56.4 kg N from liquid manure
Cattle from 6 months to 1 year	170 Mg of manure 129.2 m^3 of liquid manure	3.1	3.4	-	527 kg N from manure; 439.3 kg N from liquid manure

Description and analysis for the farm No. 3

Farm No. 3 covers an area of 65 ha. Of this, 55 ha is arable land, and the remaining 10 are permanent grassland. The sowing structure includes, next to grains, the cultivation of other plants such as peas, phacelia, borage, buckwheat, bitter and sweet lupine. V and VI soil classes are predominate. Cultivation of less common plant species, mainly melliferous, is connected with an apiary run by a farmer (30 bee

colonies). Apart from an apiary, swine, cattle and in smaller number horses, sheep and poultry are bred on the farm. The sows farrow on average 2.5 times a year, the average number of piglets in 1 litter is 9. Demise accounts for 6%. This gives approximately 535 piglets per year. Piglets from birth to sale stay on the farm for 7 months (2 months - piglet, 2 months - weaner, 3 months - fatling). The number of animals kept on the farm in 2018, depending on the species and age, was respectively in pieces: dairy cows - 8; calves up to 6 months - 4; heifers over 1 year - 2; heifers from 6 months to 1 year - 1; beef cattle from 6 months to 1 year - 5; beef cattle over 1 year- 7; boars - 1; sows - 25; in total piglets, weaners, fatlings - 535; horses - 2; sheep - 2; laying hens- 20; broilers 30; ducks - 25 and geese - 13. The cattle herd is entirely kept in a shallow bed litter flooring system. Swine, i.e. sows, boars and piglets up to 2 months - are kept on shallow bed litter flooring, while weaners and fatlings - deep bed litter flooring. The farm has 4 chambers for bed litter flooring breeding with dimensions 6 m x 7.5 m. From 25 to 30 fatlings can be kept in one of them. There are manure pads, both with an area of 176m^2, outside by the building with swine and cattle. There is a liquid manure tank with a volume of 120m^3 under the manure pad for swine, while the liquid manure tank for cattle has a volume of 155m^3. Manure from deep bed litter flooring is exported after the sale of fatlings, approx. every 4 months. If these are months when it is forbidden to use it on arable land, then it is taken to the edge of the field, where it will be used in the spring. Manure from manure pads and liquid manure are transported twice a year, in spring and autumn. The average annual production volume of natural fertilizers in this farm is presented in Table 5. Average annual production of manure amounts to: 187.2 Mg from cattle; 523.8 Mg from swine and 10 Mg from horses. Calculated to pure nitrogen (Table 6), this gives almost 465 kg of pure nitrogen from cattle production; 256 kg of N from swine production and 17 kg of N related to keeping horses on the farm. As far as liquid manure is concerned, approx. 191 m^3 of this fertilizer is produced on the farm No. 3 during the year, of which 64% comes from the cattle breeding; 33% from swine breeding and only 3% comes from horses. Calculating the obtained results to the amount of pure nitrogen (Table 6), the following data was obtained: 315 kg of N from cattle breeding; 202 kg of N from swine breeding and approx. 8 kg from keeping horses.

Table 5. Average annual production volumes of natural fertilizers on the farm No. 3

Species/ technological group of animals	The number of animals bred during the year	Maintenance system			Average annual production of natural fertilizers
		Deep bed litter flooring	Tile litter		
		manure	manure	liquid manure	
		Production (Mg/a) from 1 piece	Production (Mg/a) from 1 piece	Production (Mg/a) from 1 piece	Mg *or* m^3
CATTLE					
Dairy cows	8	-	10.0	6.2	80 Mg of manure 49.6 m^3 of liquid manure
Calves up to 6 months	4	-	1.6	1.4	3.2 Mg of manure 2.8 m^3 of liquid manure
Heifer from 6 months to 1 year	1	-	3.4	2.4	1.7 Mg of manure 1.2 m^3 of liquid manure
Heifers above 1 year	2	-	6.0	5.8	12 Mg of manure 11.6 m^3 of liquid manure
Beef cattle from 6 months to 1 year	5	-	5.0	3.8	12.5 Mg of manure 9.5 m^3 of liquid manure
Store cattle above 1 year	7	-	7	6.9	49 Mg of manure 48.3 m^3 of liquid manure
SWINE					
Knout	1	-	3.2	1.9	3.2 Mg of manure 1.9 m^3 of liquid manure
Sows	25	-	3.7	1.8	92.5 Mg of manure 45 m^3 of liquid manure
Piglets to 2 months	535	-	0.3	0.2	26.8 Mg of manure 17.8 m^3 of liquid manure
Weaner from 2 to 4 months	535	1.5	-	-	133.8 Mg of manure
Fatling	535	2.0	-	-	267.5 Mg of manure
HORSES					
Mare	2	-	5.0	2.0	10 Mg of manure 4 m^3 of liquid manure

Table 6. Concentration of nitrogen in natural fertilizers produced on the farm No. 3

Species / technological group of animals	Average annual production of natural fertilizers [Mg *or* m^3]	Maintenance system			The concentration of nitrogen in the pure component [kg N]
		Deep bed litter flooring	Tile litter		
		manure	manure	liquid manure	
		Content (kgN/Mg)	Content (kgN/Mg)	Content (kgN/m^3)	
CATTLE					
Dairy cows	80 Mg of manure 49.6 m^3 of liquid manure	-	2.8	2.7	224 kg N from manure; 133.9 kg N from liquid manure
Calves up to 6 months	3.2 Mg of manure 2.8 m^3 of liquid manure	-	2.8	3.2	10.24 kg N from manure; 9 kg N from liquid manure
Heifer from 6 months to 1 year	1.7 Mg of manure 1.2 m^3 of liquid manure	-	3.5	3.7	6 kg N from manure; 4.4 kg N from liquid manure
Heifers above 1 year	12 Mg of manure 11.6 m^3 of liquid manure	-	2.8	2.7	33.6 kg N from manure; 31.3 kg N from liquid manure
Store cattle from 6 months to 1 year	12.5 Mg of manure 9.5 m^3 of liquid manure	-	3.1	3.4	38.8 kg N from manure; 32.3 kg N from liquid manure
Store cattle above 1 year	49 Mg of manure 48.3 m^3 of liquid manure	-	2.7	2.9	132.3 kg N from manure; 104.1 kg N from liquid manure
SWINE					
Knout	3.2 Mg of manure 1.9 m^3 of liquid manure	-	3.1	3.3	10 kg N from manure; 6.27 kg N from liquid manure
Sows	92.5 Mg of manure 45 m^3 of liquid manure	-	4.0	4.2	370 kg N from manure; 189 kg N from liquid manure
Piglets to 2 months	26.8 Mg of manure 17.8 m^3 of liquid manure	-	0.9	0.4	24.1 kg N from manure; 7.1 kg N from liquid manure
Weaner from 2 to 4 months	133.8 Mg of manure	2.4	-	-	321.1 kg N from manure;
Fatling	267.5 Mg of manure	4.2	-	-	1123.5 kg N from manure;
HORSES					
Mare	10 Mg of manure 4 m^3 of liquid manure	-	1.7	1.9	17 kg N from manure; 7.6 kg N from liquid manure

Description and analysis for the farm No. 4

Farm No. 4 covers the area of 11 ha (9 ha - agricultural land, 2 ha - permanent grasslands). The farm is run in a traditional way. Harvested crops allow to fully cover the demand for animal feed, a small surplus is sold.

Table 7. Average annual production volumes of natural fertilizers on the farm No. 4

Species/ technological group of animals	The number of animals bred during the year	Maintenance system		Average annual production of natural fertilizers
		Tile litter manure	liquid manure	
		Production (Mg/a) from 1 piece	Production (Mg/a) from 1 piece	Mg or m^3
CATTLE				
Dairy cows	2	10.0	6.2	20 Mg of manure 12.4 m^3 of liquid manure
Calves up to 6 months	2	1.6	1.4	3.2 Mg of manure 2.8 m^3 of liquid manure
Store cattle above 1 year	3	7	6.9	21 Mg of manure 20.7 m^3 of liquid manure
SWINE				
Sows	2	3.2	1.9	6.4 Mg of manure 3.8 m^3 of liquid manure
Piglets from 0-4 weeks	64	0.3	0.2	1.6 Mg of manure 1.1 m^3 of liquid manure
Piglets from 4 to 8 weeks	40	0.3	0.2	1 Mg of manure 0.7 m^3 of liquid manure
Weaner from 2 to 4 months	40	1.1	0.5	7.3 Mg of manure 3.3 m^3 of liquid manure
Fatling from 4 to 7 months	40	1.5	1	15 Mg of manure 10 m^3 of liquid manure
RABBITS				
Males	1	0.15	0.13	0.15 Mg of manure 0.13 m^3 of liquid manure
Females	2	0.17	0.11	0.3 Mg of manure 0.2 m^3 of liquid manure
Youngs	20	0.08	0.05	1.6 Mg of manure 1 m^3 of liquid manure

The farm has one cowshed, where on average, the following number of farm animals are bred: swine (2 sows - they farrow approx. 2.5 times a year, 13 piglets in a litter, demise amounts to 2%, which gives approx. 64 piglets per year. 40 piglets from birth to sale as fatlings are bred on the farm. 24 pieces are sold after 4 weeks of birth. Piglets from birth to sale stay on the farm for 7 months (2 months – piglet, 2 months - weaner, 3 months - fatling)., cattle (2 cows, 2 calves up to 6 months, 3 beef cattle over 1 year), poultry (laying hens - 10 pieces, broilers - 25 pieces) and rabbits (1 male, 2 females, 20 young).

All animals are kept in a shallow bed litter flooring system. Next to the cowshed, but under the roof, there is a manure pad with an area of 35m^2. The height of manure laying is approx. 2m. Under the manure pad, there is a liquid manure tank with a volume of 130m^3. Manure and liquid manure are exported three times a year: in spring, after harvest in summer, and in autumn before winter plowing. The concentration of pure nitrogen introduced into the environment during field fertilization with organic manure is presented in Table 8.

Table 8. Concentration of nitrogen in natural fertilizers produced on the farm No. 4

Species/ technological group of animals	**Average annual production of natural fertilizers**	**Maintenance system Tile litter**		**The concentration of nitrogen in the pure component**
		manure Content (kgN/Mg)	**liquid manure Content (kgN/m^3)**	
	Mg or m^3			**kgN**
		CATTLE		
Dairy cows	20 Mg of manure 12.4 m^3 of liquid manure	2.8	2.7	56 kg N from manure; 33.5 kg N from liquid manure
Calves up to 6 months	3.2 Mg of manure 2.8 m^3 of liquid manure	2.8	3.2	9 kg N from manure; 9 kg N from liquid manure
Store cattle above 1 year	21 Mg of manure 20.7 m^3 of liquid manure	2.7	2.9	56.7 kg N from manure; 60 kg N from liquid manure
		SWINE		
Sows	6.4 Mg of manure 3.8 m^3 of liquid manure	4.0	4.2	25.6 kg N from manure; 16 kg N from liquid manure
Piglets from 0-4 weeks	1.6 Mg of manure 1.1 m^3 of liquid manure	0.9	0.4	1.4 kg N from manure; 0.4 kg N from liquid manure
Piglets from 4 to 8 weeks	1 Mg of manure 0.7 m^3 of liquid manure	0.9	0.4	0.9 kg N from manure; 0.3 kg N from liquid manure
Weaner from 2 to 4 months	7.3 Mg of manure 3.3 m^3 of liquid manure	1.9	0.8	13.9 kg N from manure; 2.6 kg N from liquid manure
Fatling from 4 to 7 months	15 Mg of manure 10 m^3 of liquid manure	4.4	4.6	66 kg N from manure; 46 kg N from liquid manure
		RABBITS		
Males	0.15 Mg of manure 0.13 m^3 of liquid manure	2.9	3.1	0.4 kg N from manure; 0.4 kg N from liquid manure
Females	0.3 Mg of manure 0.2 m^3 of liquid manure	3.2	3.3	1 kg N from manure; 0.7 kg N from liquid manure
Youngs	1.6 Mg of manure 1 m^3 of liquid manure	2.6	2.8	4.2 kg N from manure; 2.8 kg N from liquid manure

On farm No. 4, the largest amounts of nitrogen come from swine. The value in terms of pure nitrogen is almost 177 kg. At the same time, the amount of nitrogen produced during cattle breeding is 171 kg, while during the rabbit breeding is around 9.5 kg.

CONCLUSIONS

Analysis of the possibility of environmental pollution with nitrates from agricultural sources, carried out for the purpose of this study on 4 farms characterized by various types of animal production, showed that on none of the farms the amount of nitrogen from natural fertilizers, which is a side effect of conducting livestock production, exceeded 50 kg N/ha . The largest presented farm with an area of 221 ha has produced over 7,541 kg of N, which calculated per 1 ha gave 34.12 kg N/ha. The lowest result per 1 ha was recorded on farm No. 1, it amounted to 4.82 kg N/ha.

Table 9. The sum of nitrogen in the pure component is produced from natural fertilizers and the average dose of manure in t / ha, on farms 1 - 4.

Farm No.	The concentration of nitrogen in the pure component kgN	Farm area ha	Average annual dose of nitrogen from natural fertilizers kgN/ha
1	482	100	4.82
2	7,541	221	34.12
3	2,871.6	65	44.18
4	406.8	11	36.98

These results are closely related to the type of animal production that dominates on individual farms. The lowest result was achieved on a farm producing only swine, which, compared to cattle, produces nearly 70% less manure. Worrying, however, is the fact that, none of the presented farms examines the soil in terms of the need for minerals. The use of a fertilizer dose for years depends only on the variety of the plant that is being grown. The soil acidity is also not tested, which makes it impossible to determine the required dose of lime per ha.

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