MANURE MANAGEMENT STORE AT THE CATTLE FARM LEVEL AND ENVIRONMENTAL IMPACT

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Abstract
For farmers it is very important to optimize the sizing of manure storage facilities depending on the size of livestock and agricultural land fertilization periods. Kept in farm manure should not affect the environment through direct pollution of surface waters. Also, storage areas must be accessible, easy to use and maintain. It should be emphasized that manure is not useless waste, these being considered very valuable manure used to fertilize not only plants, but also to improve soil structure. However, their inappropriate use can lead to contamination of groundwater by nitrates and ammonia emissions to air. Regarding the environmental impact of manure storage facilities there are two European directives that must be considered: Council Directive 91/676/EEC of 12 December 1991 concerning the protection of waters against pollution caused by nitrates from agricultural sources and Council Directive 96/61/EEC of 24 September 1996 concerning integrated pollution prevention and control. Council Directive 91/676/EEC of 12 December 1991 provides that Member States need to establish codes of good agricultural practice. In Romania, this directive is transposed by Order no. 1182 of 22 November 2005 on the Code of Good Agricultural Practice for the protection of waters against pollution caused by nitrates from agricultural sources. The implementation of this code by farmers is obligatory if they farm in areas declared vulnerable to nitrate pollution and voluntary, whether farmers have farms in non-vulnerable areas nitrates.

Keywords: manure, management, storage, nitrate, pollution, dairy cows, calves.

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1. INTRODUCTION

It is very important to optimize the sizing of manure storage facilities depending on the size of livestock and agricultural land fertilization periods [4].
Kept in farm manure should not affect the environment through direct pollution of surface waters [1].
Gravity environmental impact will depend on the amount and concentration of the pollutant (manure) and water quantity and quality and biota receiving this pollutant.
The impact can also vary depending on the time of year at which the capacity of the dilution coefficients aeration, dissolved oxygen, sensitivity to phosphorus and nitrogen being discharged and distance which are the main sources of drinking water .
The impact must recognize that sewage discharge any concentration in water accumulation is not or is rarely accepted by society.
However, their inappropriate use can lead to contamination of groundwater by nitrates and ammonia emissions to air [6].
Code of Good Agricultural Practice contains provisions which relate, inter alia to, manure storage, both solid and liquid fertilizer application on agricultural land.
Code of Good Agricultural Practice states that the capacity of manure storage to consider the following factors:

- Type and size of animals
- The organization of farm
- Quality management applied
- Duration of storage
- Type of storage
- Method for handling manure
- The slurry dilution due to rain or other types of water

The implementation of this code by farmers is obligatory if they farm in areas declared vulnerable to nitrate pollution and voluntary, whether farmers have farms in non-vulnerable areas nitrates.

2.MATERIAL AND METHOD

The study was conducted in a cattle farm with a herd of 180 dairy cows and 120 calves heads.

3.RESULTS AND DISCUSSIONS

The calculation period for manure storage

Table 1. Production of animal manure, monthly (fresh animal manure)

	E	F	G	H
Animal category	Heads	Production of fresh manure animal	The volume of manure produced per animal (m^3/month)	The month total volume of manure produced per animal (m^3/month)
Dairy cows	180	95%	0.95	153,9
Calves	120	95%	0.75	85.5
TOTAL				**239,4**

If a dairy cow produce 30 kg / day of manure - 900 kg per month => 0,9mc / month
If a calf produce 25kg / day of manure - 750 kg per month => 0,75mc / month.
With a coefficient of 95% manure collection.
=>

$$H = E_1 + E_2 \times F_1 + F_2 \times G_1 + G_2$$

$$H_1 = E_1 \times F_1 \times G_1 = 180 \times 0{,}95 \times 0{,}95 = 153{,}9\ m^3 / \text{month}$$

$$H_2 = E_2 \times F_2 \times G_2 = 120 \times 0{,}95 \times 0{,}75 = 85{,}5\ m^3 / \text{month}$$

where:
• H - manure monthly total volume produced in the farm;
• H1 - dairy cows manure monthly total volume produced (m^3/ month);
• H2 - total monthly volume of manure produced by the calves category (m^3/ month);
• F1 - F2 - coefficient of proportion manure collected fresh (%);
• G1 - the volume of manure produced per animal for the dairy cows (m^3/ month);
• G2 - volume of manure produced per animal for the calves (m^3/ month);
• E1 - E2 total number of animals in each category dairy cows / calves.

Are included all dirty concrete surfaces, the occupied feed heaps and heaps of manure if surface runoff drains to the slurry of manure collection. Excludes pens clean and covered areas where rainwater that falls on them is collected and discharged in a clean drain. These areas being taken into account if it drains into the storage tank (Table 2).

Table 2. Calculation of the rain that falls directly on the storage tank and concrete surfaces storage tank drained (monthly)

A	B	C
Surface storage tank and other concrete surfaces they discharge manure storage basin (m^2)	The average monthly rainfall (mm)	Rainfall monthly volume storage tank (m^3/ month)
1657	650	107,7

$$C = A \times B$$

$$C = (1657 \times 650) : 10000 = 107{,}7\ (m^3/\text{month})$$

where:
• C - rainfall monthly volume storage tank (m^3/ month)
• A - surface storage tank and other concrete surfaces they discharge manure storage basin (m^2)
• B - the average monthly rainfall (mm).
It has been calculated that the volume of manure stored monthly total garbage output with added monthly rainfall and the amount of waste water for washing dairy cow paddocks (Table 3, 4).

Table 3. The volume of wastewater from washing milk cowshed

Dairy cows heads	Wastewater/ month
180	105 m^3

Table 4. The calculation of the monthly volume of stored manure

A	B	C	D
Qty. of garbage produced for one month (m^3/ month)	Qty. of monthly rainfall (m^3/month)	Qty. of water used for washing (m^3/month)	TOTAL (m^3/month)
239,4	107,7	105	452,1

D = A + B + C
where:
D = total volume of stored manure (m^3/ month);
A = Qty. of garbage produced for one month (m^3/ month);
B = Qty. of monthly rainfall (m^3/ month);
C = Qty. of water used for washing (m^3/ month).
If the storage lagoon reinforced embankments of earth is estimated length (meters) and width (meters) thereof, then the average depth is measured (meters) from the top of the slope at the base of the lagoon. Depth will be 0.75 m lower than the average depth calculated, given that manure expands during fermentation. The interior length and width is calculated based on the embankment slope. By multiplying the three dimensions to obtain the storage capacity in cubic meters.
Existing storage capacity is known as 2550 m.

Table 5. Manure storage period in months

T_1	T_2	T
Existing storage capacity at the farm (m^3)	**Monthly stored volume of manure produced (m^3/ month)**	**Available manure storage period (months)**
2550	452,1	5,6

$T = T_1 : T_2$
$T = 2550 : 452{,}1 = 5{,}6$
where:
• T - available manure storage period expressed in months;
• T1 - existing storage capacity at the farm;
• T2 - stored volume of manure produced during one month.

Environmental impact
Nitrogen mineralization
Organic nitrogen is converted to inorganic nitrogen during manure mineralization so is used by the plants. This transformation process is in two directions, namely that not only consumes nitrogen but also releases nitrogen. The optimum temperature is between $+9^0$ C to $+ 35^0$ C, soil with a pH between 5.8 to 8.5, these organisms are very sensitive to lower the pH below 5.8 (Table 6).

Table 6. The total concentration of ammonia (NH3 + NH4) depending on the temperature and pH. (mg / l)

Temp. (C^0)	**Amounts of pH**						
	6	**6,5**	**7**	**7,5**	**8**	**8,5**	**9**
5	160	51	16	5,1	1,6	0,53	0,18
10	110	34	11	3,4	1,1	0,36	0,13
15	73	23	7,3	2,3	0,75	0,25	0,09
20	50	16	5,1	1,6	0,52	0,18	0,07
25	35	11	3,5	1,1	0,37	0,13	0,06

The energy that is released in the process stimulates soil microbial fauna, which leads to the consumption of nitrogen in a higher rate than is produced by the mineralization process.
Thus, due to the intense activity of the microbial fauna initial mineralization process, can lead to a reduction in available nitrogen requirement for plant growth and development.
Nitrogen deficiencies can occur in plants rapid development phase when the mineralization can not provide the required amount. This phenomenon occurs especially in spring when the soil warms [2].
Ammonium Nitrogen (NH4) is the first item in the mineralization of organic nitrogen. It is further oxidized to nitrate by nitrifying bacteria.
Nitrate form of nitrogen fixation in the soil is likely and can be fixed underneath the plant roots before it to be used for plant growth.
Nitrate can contaminate soil if it snaps beneath the roots of the plants or if transported by surface runoff.

Soils that have high permeability and contribution rate, coarse texture or shallow water table, are susceptible to nitrate contamination of groundwater.

Microbial activity

Microbial composition of manure and its activity grow considerably mineralization rate of organic manure. Soil moisture, temperature and aeration, microbial activity and adjusts these factors, the rate of mineralization.

Soils that are warm, moist and well aerated, have the greatest potential to have a greater microbial activity and thus as a high rate of mineralization. It is expected a decreased activity, and a low rate in the soil cold saturated water and dried [6].

Manure applied to a cold mineralized ground is difficult and also is difficult or impossible to incorporate and is a vulnerable surface erosion and leakage.

The greatest potential pollution of surface waters is when manure is applied in these circumstances.

Microbial activity is also very dependent on the amount of water in the soil. The soil that is dried throughout the entire season, have a small rate of mineralization of organic matter.

It is becoming very intense microbial activity immediately following rainfall or irrigation and decreasing again with decreasing humidity. Conversely, soils that have a high moisture content throughout the season, have high microbial activity and a high capacity for organic manure mineralization.

Wet soils are saturated and water throughout the season have a low activity, thanks not to the lack of water but for the air lack of soil.

4. CONCLUSIONS

- Valuable organic fertilizer manure is used to fertilize not only plants, but also to improve soil structure.
- Compliance with minimum distances stipulated in legislation for the placement of deposits of manure to not endanger water sources close to them and to minimize the impact on surrounding areas.
- Creation of deposits and manure storage lagoons respecting building service using their sealing waterproofing materials to prevent contamination of soil, surface water and groundwater.
- Appropriate location of the farm and taking into account prevailing wind direction to eliminate or reduce the impact of odors on surrounding areas (residential areas).
- Application Specific treatments to reduce odor emissions, to destroy a large part of the pathogens (composting).
- Distribution of garbage on the ground through methods that reduce emissions significantly as ammonia and incorporated as quickly as possible to reduce emissions.
- The accurate processing of manure to be spread on land. It must do the following:
  • to recover the residual energy (biogas);
  • to reduce the nitrogen content of compost to prevent pollution of surface water, groundwater or to prevent odors;
  • to reduce emissions during storage or spreading.

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