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Emissions of Air Pollutants From the Livestock Production in Ukraine

O. M. Zhukorskiy¹, L. I. Moklyachuk², O. V. Nykiforuk²

¹National Academy of Agrarian Sciences of Ukraine
37, Vasylykivska Str., Kyiv, Ukraine, 03022

²Institute of Agroecology and Environmental Management NAAS
2, Metrologichna street, Kyiv, Ukraine, 03143

e-mail: o_zhukorskiy@ukr.net

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Aim. To research the contribution of the poultry activity of Ukraine to emissions of environmental pollutants and estimate possible emissions by various meat production sub-sectors on the basis of their structure. **Methods.** We used informational databases and methods of calculating emissions of polluting substances (excluding greenhouse gases) to the atmosphere as well as methane emissions. **Results.** In Ukraine the cattle raising, pig rearing and poultry breeding are developed the most intensively. They provide 17.9; 31.3 and 48.9 per cent of the meat production accordingly and considerably influence the environment. In the structure of emissions caused by animal industry, poultry breeding includes 62-76 per cent: the mass of microorganisms getting into the air is 12.2. times higher than by cattle raising, and 2.28 times higher as to pig rearing; the level of dust emissions is 16.3 times higher than that by cattle raising, and almost 6 times exceeds the emissions caused by pig rearing. Poultry breeding causes the highest amount of hazardous emissions per 1 ton of the produced meat. Methane emissions from poultry breeding are comparatively insufficient; their part is only 0.3 per cent of the total number of emissions in the animal industry. Cattle raising and pig rearing make up 84.1 and 11.9 per cent accordingly. While producing 1 ton of cattle meat, 844.1 kg of methane is burst out, and 68.3 kg/t in case of pig rearing. Pig rearing has a leading position in methane emissions from manure. **Conclusions.** Poultry breeding makes the greatest contribution to emissions (polluting chemical substance (excluding greenhouse gases), microorganisms, dust) – ~ 72 per cent, pig rearing makes up ~ 19 per cent, other sub-sectors make up ~ 9 per cent. Cattle raising has the highest level of methane emissions – 84 per cent, as far as manure are concerned, most of methane is outburst in pig rearing – 65 per cent.

Keywords: environmental pollutants, food-producing animals, methane emissions, beeves, pigs, poultry science, manure.

INTRODUCTION

Animal industry has a serious role along with basic air pollutants such as automobile transport, industry, power engineering, etc. Herewith, the negative effect can be caused both by animals and their biowastes as well as all production processes that take place on farms.

As a result of raising agricultural animals, the following categories of polluting substances get into the air [1]: ammonia, hydrogen sulphide, methane, alcohols (methanol, ethanol, etc.), carboic acids, sulphides and disulphides, mercaptans, ammoniac, carbonic oxides, as well as microorganisms, wool and down dust. Such

emissions as methane, ammonia and carbonic oxides also create so-called greenhouse effect in the atmosphere and contribute to increasing in the temperature in its bottom layers [2].

A part of the Ukrainian agricultural sector in aggregate emissions of greenhouse gases was 9 per cent in 2010 [3]. In the Ukrainian animal industry poultry breeding and pig rearing are the basic sources of greenhouse gas emissions through wastes of the production at various stages of their utilization and treatment that get into the air and mainly are presented by purulent masses [4].

Cattle breeding enterprises unlike manufacturing are characterized by the fact they pollute the environment not only with chemical substances, but also various live microorganisms [5]. The combination of all technological processes that take place on farms during producing cattle products is followed by the dissolution of organic substances. Besides, animals themselves are also a significant source of dangerous components emissions into the air. More than that, a significant number of dust gets into the air through ventilation systems around cattle breeding enterprises.

All these harmful components influence on the environment rather negatively and create unfavorable conditions of human beings, animals and flora existence.

Basic ecological problems that arise in the process of innovative development of the animal industry in Ukraine lie in the fact that the increase in the livestock and production concentration results in the level of the environment pollution (the coefficient of emissions of greenhouse gases, such as methane and aerial nitrogenous precipitations increase) [3, 4].

There is a very tense ecological situation around big livestock complexes (in the radius of several kilometers) – every day they produce thousands tons of excrements that cannot be processed in the household. Unfavorable sanitary and hygienic situation appears close to them, the increased concentration of helminths and pathogenic bacteria is observed. Air flows carry stink for kilometers around complexes.

The increase of pig and poultry livestock, implementation of the programs aiming to increase the cattle livestock in Ukraine require constant monitoring of the environment condition. It will allow to facilitate the ecologic load of harmful components on facilities of

the environment due to meeting all technological requirements to placing and constructing animal industry facilities, technologies related to keeping and feeding animals, support of the relevant micro-climate both inside the facilities, where animals are kept and on the territory of the farm.

Therefore, the aim of this work was to analyze the contribution of the Ukrainian animal industry to pollutants emissions into the air and estimate possible emissions from various sub-sectors of meat production on the basis of their structure.

MATERIALS AND METHODS

The contribution of the animal industry to pollutants' emissions was analyzed and estimated with the use of national informational databases [6] and methodologies of calculating pollutants emissions (excluding greenhouse gases) into the atmosphere [1] as well as methanes outbursts [7].

RESULTS AND DISCUSSION

Due to adoption and implementation of the programs related to the development of animal sub-sectors in Ukraine, last years the positive dynamics in the increase in the number of cattle, pig and poultry (Table 1), rise of producing animal products is observed. Herewith, the number of pig is gradually increasing, following poultry breeding that occupies the first position. For the last three years (2011–2013) the number of pig in Ukraine has increased in 7.4 per cent, and 12.2 per cent in the live weight that makes this sector one of the leaders of meat producers.

Three lines – cattle raising, pig rearing and poultry breeding – develop the most intensively. They provide

Table 1. Livestock In Ukraine, Thousand of Animals

Animals group	As of			Deviation	Percent of 2014 as to 2012
	01.01.2012	01.01.2013	01.01.2014		
Cattle	4,425.8	4,645.9	4,534.0	+108.2	102.4
Pig					
Sheep and goats	7,373.2	7,576.7	7,922.2	+549	107.4
Horses	1,739.4	1,738.2	1,735.2	-4.2	99.8
Poultry	395.7	376.6	354.2	-41.5	89.5
Rabbits	200,760.6	214,070.6	230,289.8	+29,529.2	114.7
	5,642.7	5,657.5	5,735.4	+92.7	101.6

EMISSIONS OF AIR POLLUTANTS FROM THE LIVESTOCK PRODUCTION IN UKRAINE

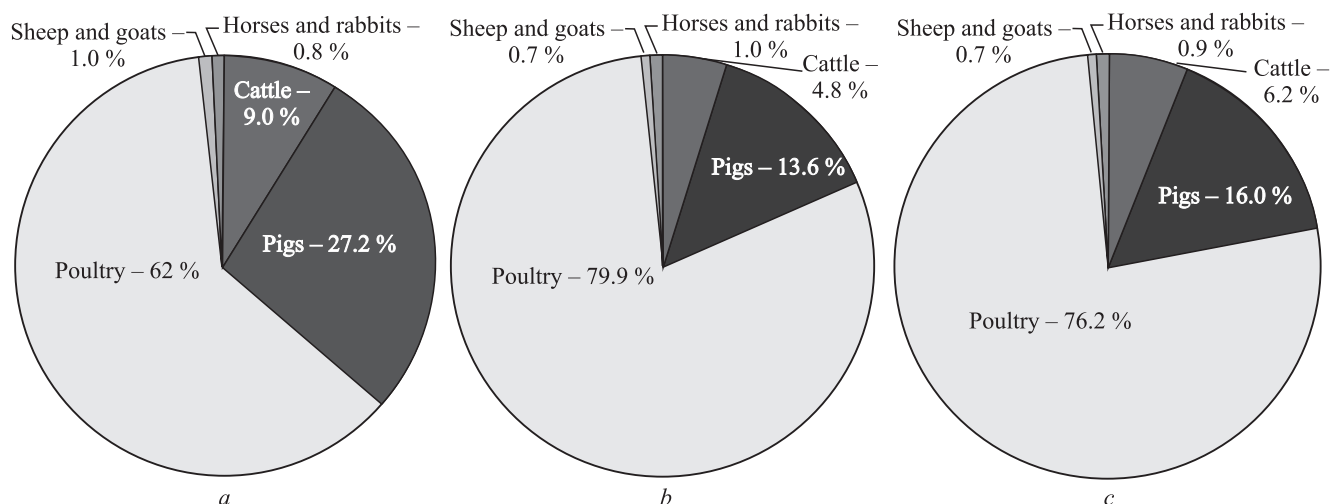


Fig. 1. Structure of emissions into air caused by animal industry of Ukraine in 2013: *a* – chemical pollutants (excluding greenhouse gases); *b* – dust; *c* – microorganisms

17.9, 31.3 and 48.9 per cent of domestic meat products in the state. It is obvious that in the general structure of animal industry these sectors influence and more likely will influence the state of the environment. Calculations of pollutants emissions into the air prove this fact (Table 2).

For the last three years producing cattle products in live weight has increased in 13 per cent in average, including poultry – 19 per cent, beef – 5 per cent, pork – 12 per cent [6]. Such growth caused by the increase in the animals number results in the increase in the level emissions of pollutants into the air (Table 2).

Emissions of pollutants caused by poultry breeding is 6.83 times higher than from cattle raising, and 2.28 times higher than from pig rearing. Poultry breeding is a serious source of emissions of microorganisms into the air. 12.2 times bigger mass of

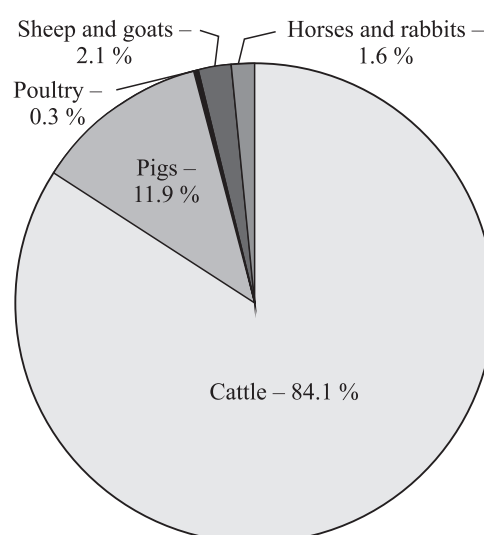


Fig. 2. Structure of methane emissions caused by animal industry in 2013

Table 2. Pollutants' Emissions (Excluding Greenhouse Gases) Into the Atmosphere Cause by Animal Industry For 2013, Tons/Year

Environmental Factor	Cattle	Pig	Poultry	Sheep, goats	Horses, rabbits	Total
Pollutants:						
t/year	1,679.0	5,073.5	11,570.5	182.5	146.0	18,651.5
kg/t of meat	3.9	6.9	9.9	9.8	5.6	7.8
Microorganisms:						
10 ⁶ cells per 1 s	1,753	4,504	21,431	191	246	28,125
10 ³ cells in 1 t of meat	4.1	6.0	18.3	10.2	9.4	11.8
Dust:						
t/year	620.5	1,752	10,256.5	84.0	127.8	12,840.8
kg/t of meat	1.5	2.3	8.8	4.5	4.9	5.4

Table 3. Methane Emissions Caused by Animal Industry In 2013, Thousand Tons/Year

Indicator	Total	Cattle	Pig	Poultry	Poultry	Sheep	Goats	Horses	Rabbits
Type of digestive fragmentation	363.7	340.8	7.9	–	–	5.3	3.3	6.4	–
From purulent substance	65.87	20.3	43.2	1.35	1.35	0.11	0.07	0.39	0.45
Total	429.57	361.1	51.1	1.35	1.35	5.41	3.37	6.79	0.45
Per cent	100	84.1	11.9	0.3	0.3	1.2	0.9	1.5	0.1
kg/t of meat	179.9	844.1	68.3	1.2	1.2	469.5		561.2	31.7

microorganisms get into the air from poultry breeding than from cattle raising, and 2.28 times bigger as to pig rearing. The contribution of poultry breeding to dust emissions is 16.3 times higher than that of cattle raising and exceeds emissions caused by cattle raising almost 6 times. Emissions per 1 ton of the produced meat caused by poultry breeding are the mostly numerous.

Poultry breeding has a leading role in the structure of emissions (Fig. 1).

In addition to various dangerous and polluting substances, agricultural animals and their biowastes are an important source of emitting greenhouse gases into the atmosphere.

Methane is the most dangerous among greenhouse gases, and the basis source of its emission includes cattle and ruminants. Methane is produced as a result of microbiological dissolution of dissolvable lipids, carbohydrates, organic acids, proteins and other organic compositions in ruminants' alimentary tract. Pig and other animals unlike ruminants is characterized by a low level of methane emissions through digestive fragmentation. However, the methane emission from systems of removing, storing and using pig manure is sufficient and is done mainly under anaerobic conditions [3].

Cattle, small ruminants and horses are agricultural animals being the most dangerous for climatic processes. The methane emission is 844.1 kg per 1 ton of cattle meat, while for pig it is only 68.3 kg/t of meat. Emissions from poultry breeding are relatively insufficient; their part is only 0.3 per cent of the total emissions in the animal industry, 84.1 and 11.9 per cent characterize cattle raising and pig rearing.

Pig rearing is on the second position in the general structure of the Ukrainian animal industry ac-

ording to volumes of methane emissions and nitrogen monoxide [3].

Last time there is an accurate tendency to the increase in cattle and pig on farms with the capacity from 1,000 to 5,000 animals [6]. As a rule, on such farms the project provides anaerobic ponds and other systems to store manure in the form of liquid. As manure in the form of liquid is characterized by the highest coefficients of methane conversion (0.90 for cattle and 0.39 for pig) [7], we can state that the increase in emissions from manure is higher on enterprises.

Similar dependence is also related to nitrogen that exhales as a result of producing products of pig rearing. However, the coefficient of nitrogen outburst subject to constant physical state of manure is inversely proportional to methane outburst [5]. Thus, the manure being in the solid form exhales the most of nitrogen oxide and the least of methane.

The leading position in methane emissions from manure is taken by pig rearing. It occurs due to the fact that all wastes from pig rearing are stored in settlers predominately together, while half of wastes from cattle raising and poultry breeding is believed to remain on pasture fields and places where animals are kept. Greenhouse gases are not taken into account in this category. This fact can be considered as positive as wastes in settlers are better regulated and converted while it is impossible to control the animals' wastes on pasture fields.

CONCLUSIONS

The growth of products of animal industry in Ukraine results in the increase in pollutants emissions into the air. Poultry breeding makes the greatest contribution to emissions (polluting chemical substance (excluding greenhouse gases), microor-

ganisms, dust) – ~ 72 per cent, pig rearing makes up ~ 19 per cent, other sub-sectors make up ~ 9 per cent. Cattle raising has the highest level of methane emissions – 84 per cent, as far as manure are concerned, most of methane is outburst in pig rearing – 65 per cent.

Рівень викидів забруднюючих речовин повітряного простору від галузі тваринництва в Україні

О. М. Жуковський¹, Л. І. Моклячук²,
О. В. Никифорок²

¹ Національна академія аграрних наук України
Вул. Васильківська, 37, Київ, Україна, 03022

² Інститут агроекології та природокористування
НААН України
Вул. Метрологічна, 12, Київ, Україна, 03143

e-mail: o_zhukorskiy@ukr.net

Мета. Вивчити внесок галузі тваринництва України у викиди забруднювачів довкілля та оцінити можливі викиди від різних підгалузей виробництва м'яса, виходячи з їхньої структури. **Методи.** Використано інформаційні бази даних і методи розрахунків викидів забруднюючих речовин (без парникових газів) в атмосферу, а також викидів метану. **Результати.** В Україні найінтенсивніше розвиваються скотарство, свинарство і птахівництво. Вони забезпечують відповідно 17,9; 31,3 і 48,9 % виробництва м'яса та мають значний вплив на стан довкілля. У структурі викидів від тваринництва на птахівництво припадає 62–76 %: у повітря надходить маса мікроорганізмів у 12,2 разу більша, ніж від скотарства, і в 2,28 разу більша порівняно зі свинарством; рівень викидів пилу в 16,3 разу вищий, ніж від скотарства, та майже у 6 разів перевищує викиди від свинарства. На 1 т виробленого м'яса найбільше шкідливих викидів від птахівництва. Викиди метану від птахівництва порівняно незначні, їхня частка дорівнює лише 0,3 % від загальної кількості викидів у тваринництві. Скотарству та свинарству належить відповідно 84,1 і 11,9 %. На 1 т виробленого м'яса великої рогатої худоби емісія метану становить 844,1 кг, від свиней – 68,3 кг/т м'яса. У викидах метану від гноевих мас свинарство займає лідируючу позицію. **Висновки.** Найбільший внесок у викиди (забруднюючі хімічні речовини (без парникових газів), мікроорганізми, пил) робить птахівництво – ~ 72 %; частка свинарства становить ~ 19 %, інших підгалузей – ~ 9 %. Найвищий рівень викидів метану належить скотарству – 84 %, від гноевих мас переважають викиди метану у свинарстві – 65 %.

Ключові слова: забруднювачі довкілля, сільськогосподарські тварини, викиди метану, велика рогата худоба, свині, птахівництво, гній.

Уровень выбросов загрязняющих веществ воздушного пространства от отрасли животноводства в Украине

Жуковский О.М.,¹ Моклячук Л.И.,² Никифорок О.В.²

¹ Национальная академия аграрных наук Украины
Ул. Васильковская, 37, Киев, Украина, 03022

² Институт агроэкологии и природопользования НААН
Ул. Метрологическая, 12, Киев, Украина, 03143

e-mail: o_zhukorskiy@ukr.net

Цель. Изучить вклад отрасли животноводства Украины в выбросы загрязнителей окружающей среды и оценить возможные выбросы от различных подотраслей производства мяса исходя из их структуры. **Методы.** Используются информационные базы данных и методы расчетов выбросов загрязняющих веществ (без парниковых газов) в атмосферу, а также выбросов метана. **Результаты.** В Украине скотоводство, свиноводство и птицеводство обеспечивают соответственно 17,9; 31,3 и 48,9 % производства мяса и оказывают значительное влияние на состояние окружающей среды. В структуре выбросов от животноводства на птицеводство приходится 62–76 %: в воздушное пространство поступает микроорганизмов в 12,2 раза больше, чем от скотоводства, и в 2,28 раза больше по сравнению со свиноводством; уровень выбросов пыли в 16,3 раза выше, чем от скотоводства, и почти в 6 раз превышает выбросы от свиноводства. На 1 т произведенного мяса больше всего вредных выбросов от птицеводства. Выбросы метана от птицеводства сравнительно незначительные, их доля равна лишь 0,3 % от общего количества выбросов в животноводстве. Скотоводству и свиноводству принадлежит соответственно 84,1 и 11,9 %. На 1 т произведенного мяса крупного рогатого скота эмиссия метана составляет 844,1 кг, от свиней – 68,3 кг/т мяса. В выбросах метана от навоза свиноводство занимает лидирующую позицию. **Выводы.** Наибольший вклад в выбросы (загрязняющие химические вещества (без парниковых газов), микроорганизмы, пыль) делает птицеводство – ~ 72 %; доля свиноводства составляет ~ 19 %, других подотраслей – ~ 9 %. Высокий уровень выбросов метана принадлежит скотоводству – 84 %, выбросы метана от навоза преобладают в свиноводстве – 65 %.

Ключевые слова: загрязнители окружающей среды, сельскохозяйственные животные, выбросы метана, крупный рогатый скот, свиньи, птицеводство, навоз.

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