Inventory and Assessment of Ammonia Emissions Sources in Belarus

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7th Task Force on Reactive Nitrogen,
29.02-2.03.2012, Saint-Petersburg,
Russian Federation

Introduction

Tasks of ammonia emission sources study:

- Statistical ammonia emission data analysis
- Sources of ammonia emission identification
- Procedures of ammonia emission inventory improvement
- Emission factors selection and activity rates data collection
- Ammonia emission assessment and results description
- Spatial distribution of ammonia emissions
- Ammonia emission trends
- Ammonia emission projection
- Ammonia emission sources testing
- Conclusions and further steps

Ammonia emission inventory

Ammonia belongs to substances incompletely accounted for by national statistics in Belarus. One of the main reasons: only a part of agricultural enterprises report data on their emissions. According to statistics total ammonia emission in 2008 amounted 19.6 thous. tons, including 3.3 thous. tons from industry (chemical and food) and 14.4 thous. tons from agriculture.

Complete and accurate emission inventory – starting point for further actions in ammonia and nitrogen emission regulation. Thereby applying emission factors the following ammonia emission sources were assessed: fuel combustion in power generation and processing industry, non-industrial combustion plants, combustion in processing industry, road transport and other mobile sources, waste treatment and disposal, agriculture. Emissions from manufacturing industry and some other source categories were evaluated using statistical data.

Technologies and ammonia emission factors

Technologies of animal breeding and crop production in Belarus

Analysis of animal breeding and crop production technologies was carried out using reference information, analytical reviews, regulatory documents, scientific information to select and justify ammonia emissions factors.
It was also taken into account that approximately 90% of cattle, 70% of pigs and 80% of poultry belong to agricultural enterprises.

Cattle breeding

Main systems of cattle breeding in Belarus: stall-fed, mixed grazing – stall-fed, grazing. Stall-feeding is mostly applied for calves under 1 year. Stall-fed animals can be kept tied, non- kept-tired or in boxes. In Belarus at farms the common system applied for cattle housing (90-94% of livestock) – kept tied.

Three manure storage systems are used: liquid (at large cattle-breeding facilities), solid (at farms) and at pastures.

Mostly no-bedding housing is applied for dairy cattle, the manure in this case is removed mechanically – by conveyors.

Enterprises of beef stock farming (livestock above 3000 heads) apply year round free-stall housing; at farms – stall free housing on replaceable bedding with mechanical manure removal as well as tied housing are used.

Solid manure storage is typical for cattle breeding in Belarus.

Swine breeding

Bedding and no-bedding systems in swine breeding in Belarus are used.

Bedding (straw, sawdust, peat) in swine stalls is used mostly at small and medium farms. In such farms manure is removed by manually or mechanically. Large industrial farms and agricultural enterprises apply no-bedding housing; the manure mass enters manure canals and then is diluted with water and removed by pumps.

Swine breeding enterprises apply two main manure storage systems. The first one consists of separation solid and liquid fractions with subsequent outdoor storage in piles for solid manure and accumulation in reservoirs for liquid fraction. The second manure handling system includes manure storage in manure depository with natural sludge. At swine breeding enterprises 45% of manure are stored in liquid phase, and 55% – in solid phase. No-bedding housing with manure hydro removal systems are predominant.

Poultry

There are four types of poultry production enterprises in Belarus : egg production, broiler production, poultry breeding stations and poultry incubation enterprises. At egg production enterprises poultry is kept in single-level or multi-level battery cages. Two handling systems are applied for broilers: in cage and open-floor housing. Open-floor housing in production houses means daily manure removal or removal after poultry slaughtering. Poultry dung is removed by scraper conveyors, bulldozers; also hydraulic conveyor and pneumatic systems are used.

Fertilizer application

Manure

Bedding (about 60%) and no-bedding (40%) manure is applied as fertilizer.

Bedding manure is applied mostly for autumn ploughing by agricultural processing machines and manure sprinkler systems. Liquid fraction is applied in autumn or spring for plowing or cultivation.

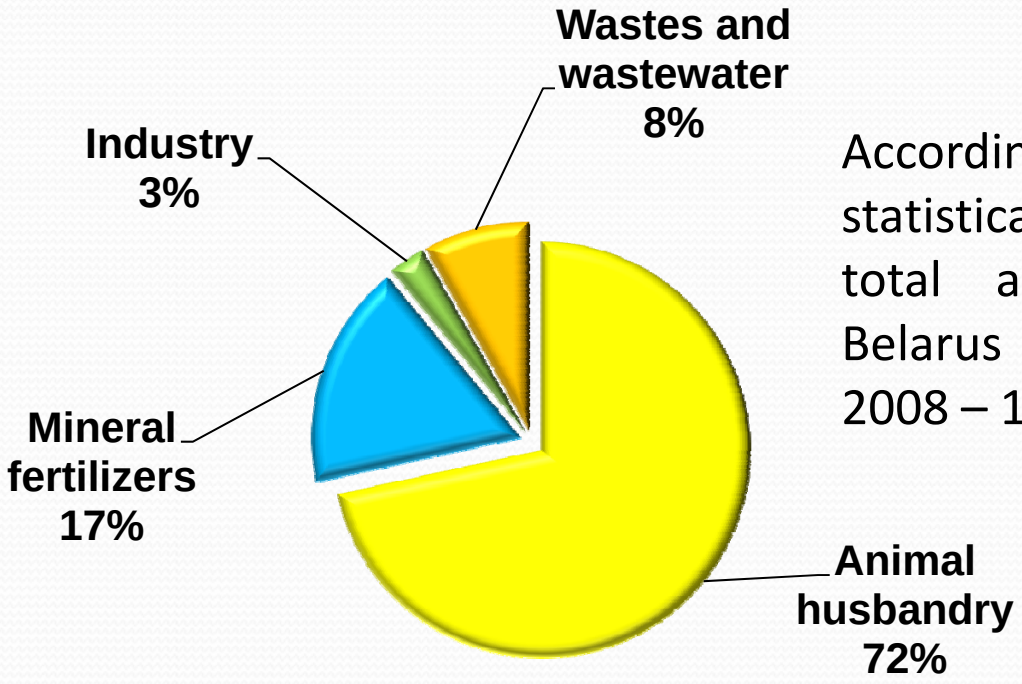
Mineral fertilizers

Surface distribution of granular mineral fertilizers and liquid fertilizers is applied.

Ammonia emission factors

Livestock group	Description of source	Emission factor, kg per head per year
Dairy cattle	liquid storage	39.3
	solid storage	28.7
	disposal on pasture land	3.9
Other cattle	liquid system	13.4
	solid storage	9.2
	disposal on pasture land	2.0
Gestating sows	liquid system	15.8
	solid storage	18.2
Other types of swine	liquid system	6.7
	solid storage	6.5
Hens	cage housing	0.48
	free grazing	0.32
Broilers	open-floor housing	0.22
	free grazing	0.16
Horses		5.1
Sheep and goats		0.46
Mineral fertilizers	Nitrogen mineral fertilizers	0.05 kg/kg
Fuels combustion	Coal, peat/firewood	10/5 g/t
Waste water	Urban/rural	0.014/1.6 kg/thous.m3
Solid wastes disposal		0.63 kg/person

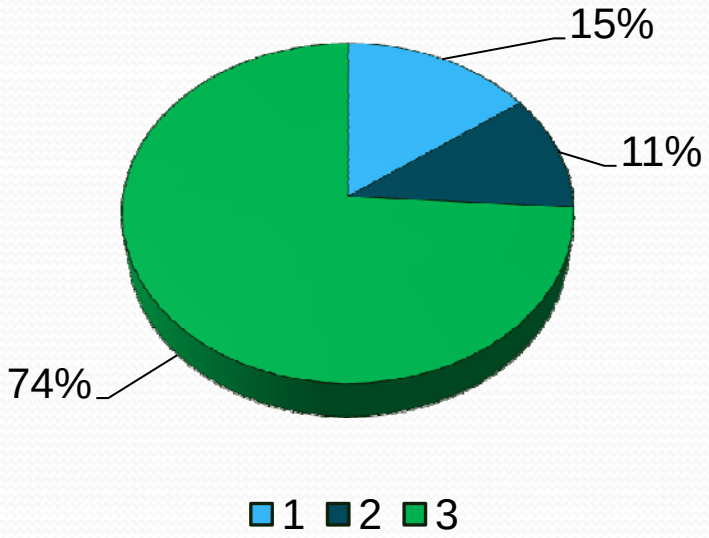
Structure of total ammonia emissions

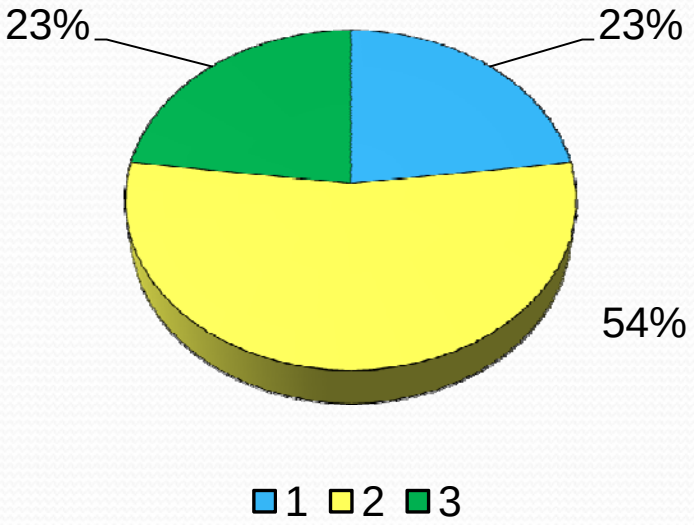


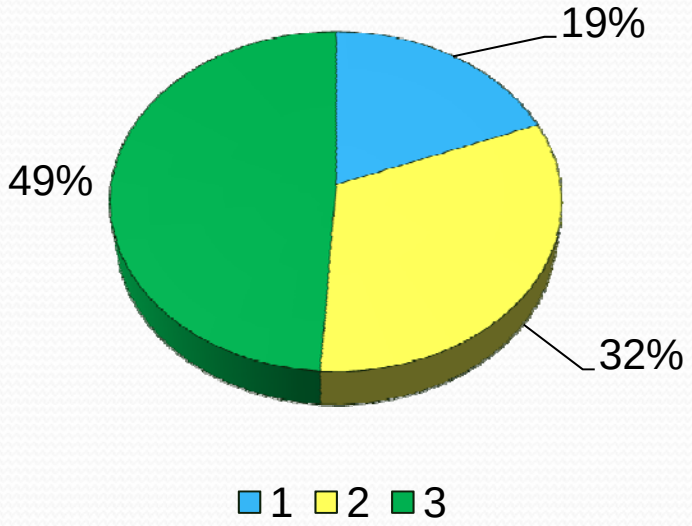
According to inventory results (including statistical data for industrial processes), total annual ammonia emissions in Belarus amount 140-150 thous. tons (in 2008 – 146 thous. tons).

Main ammonia contributors are animal husbandry activities (about 70% of total emissions); contribution of cattle breeding exceeds 45%, pigs – 16% and poultry – 7%.

Distribution of ammonia emissions from cattle (A), pigs (B), poultry (C) by types of sources







1 - private agricultural households

2 - large and medium agricultural facilities

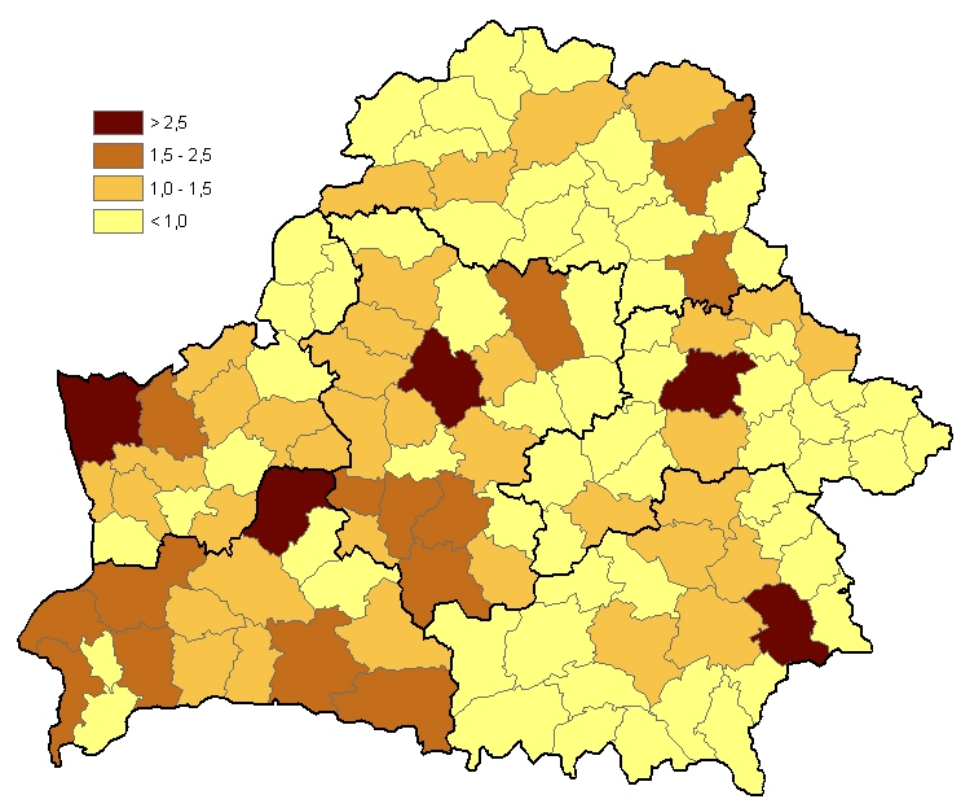
3 - small agricultural facilities

74% of ammonia emissions from cattle are due to emissions from agricultural enterprises and 15% - from private households. Ammonia contributions from large and medium facilities (more than 1500 heads of livestock) are 11% of total emissions from cattle.

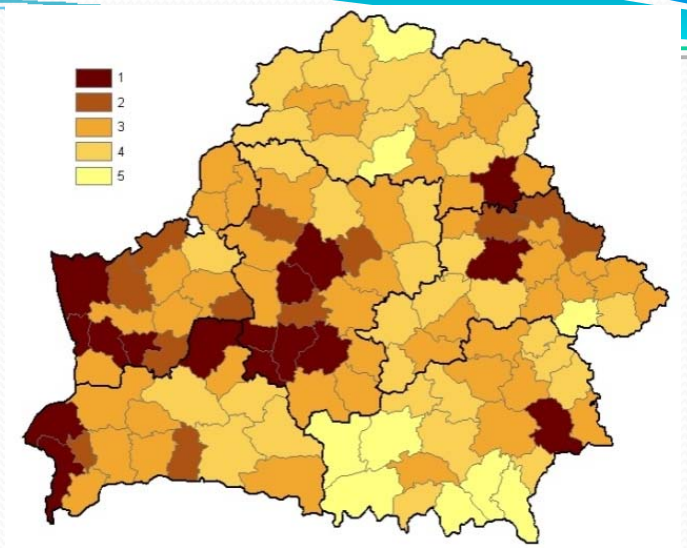
Spatially distributed emissions

Spatially distributed ammonia emissions were assessed by districts and 50x50 km2 EMEP grid. More than 500 large livestock farms were allocated and their emissions were assessed.

Total ammonia emissions by districts, Gg

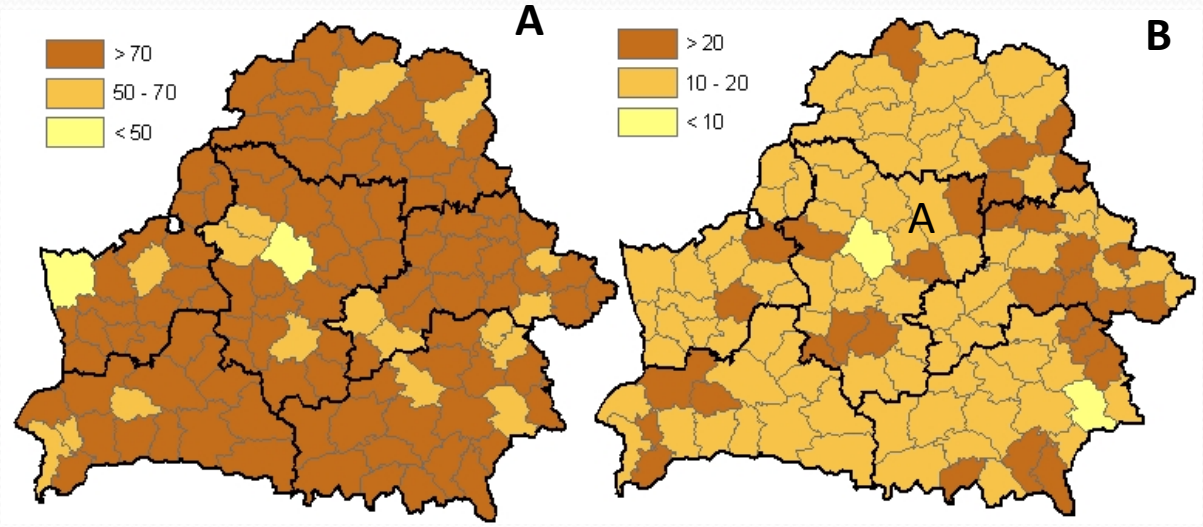


Ammonia emissions spatial density



Ammonia emissions density: 1 – the highest, 2 – high, 3 – mean, 4 – low, 5 – the lowest

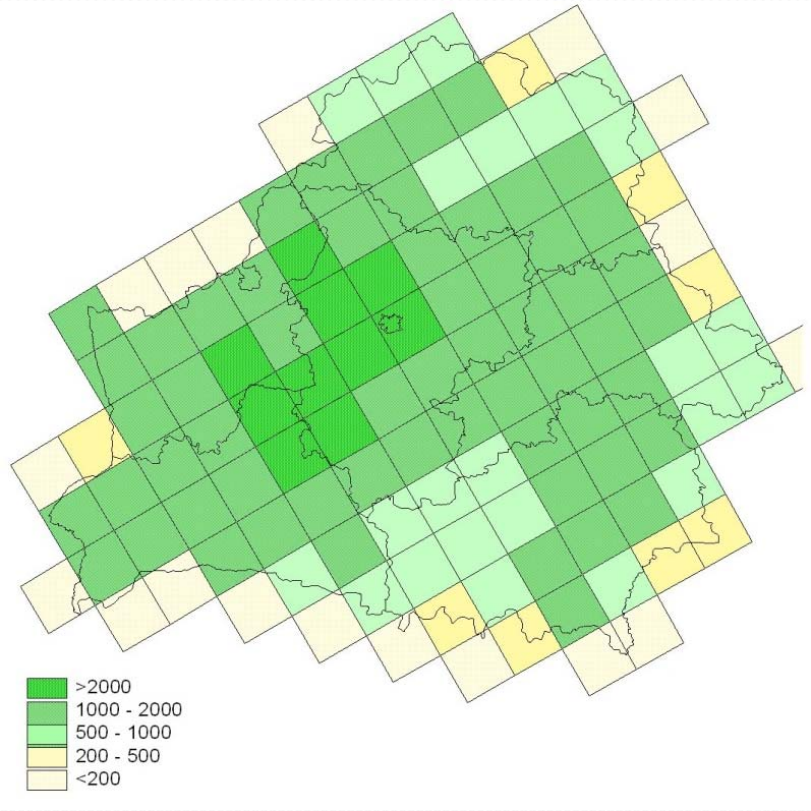
Share of animal husbandry (A) and mineral fertilizer application (B) in total emissions



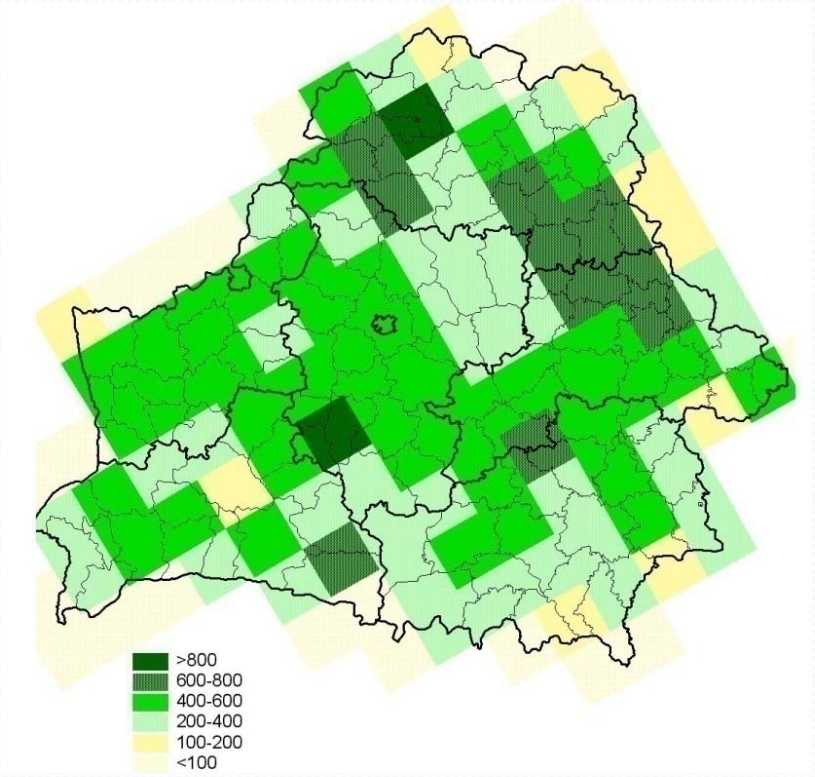
Ammonia Emissions spatial distribution

Emissions by 50x50km EMEP grid

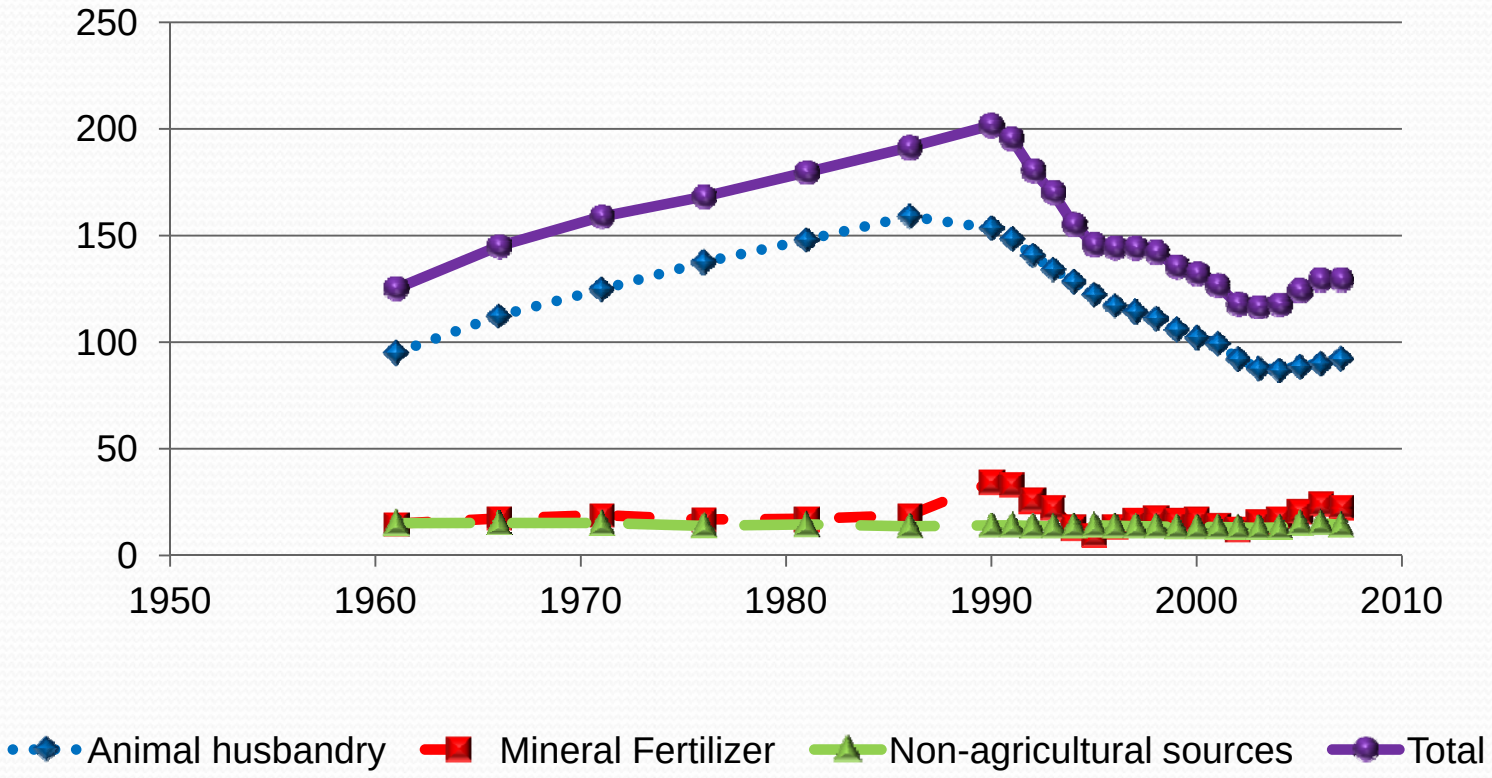
Total ammonia emission, Mg



Ammonia emission from livestock husbandry, Mg



Ammonia emissions trends



Ammonia emissions trends from 1961 were estimated. According to estimates ammonia emissions in Belarus from 1961 to 1990 were growing ; from 1990 to 2001 they were reducing and after 2001 certain growth began. Ammonia emission curve reflects mainly the livestock population dynamics.

Ammonia Emission Projections

For determination of possible changes of ammonia emissions under the impact of economic development of the country, environmental legislation and technologies improvement ammonia emission levels projection till 2020 was made.

Emission projection was based upon plans and prognosis of economic indicators, technological changes ions and environmental protection plans which impact ammonia emission accepted till 2010. Main documents: Program of Sustainable Socio-Economic Development of the Republic of Belarus till 2020, National Plan of Actions on Rational Use of Natural Resources and Environmental Protection for the period from 2005 to 2010.

Few scenarios were prepared.

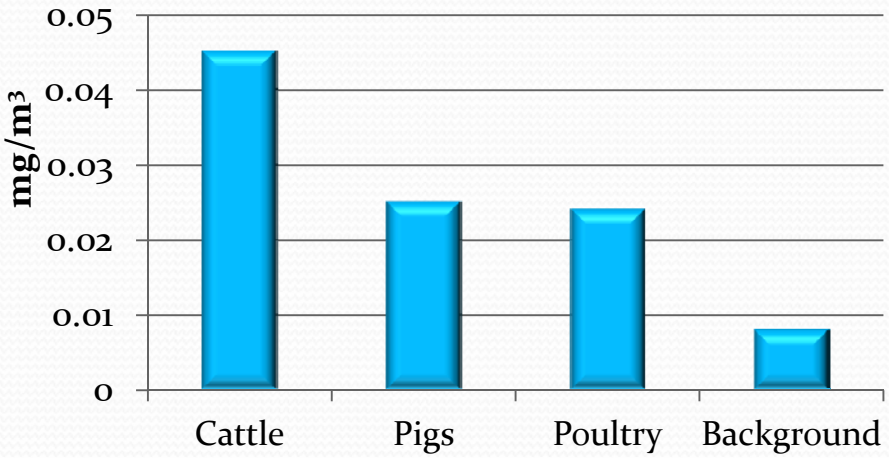
According to projections under the BAU scenario ammonia emissions will amount more than 160 thous. tons in 2020. Estimated maximum technically feasible ammonia emission reduction in livestock husbandry amount about 30-35% of current emissions.

In general agricultural sources contribute more than 80% of atmospheric ammonia emissions. Thereafter only ammonia emission reduction from these sources may decrease significantly the national ammonia emissions.

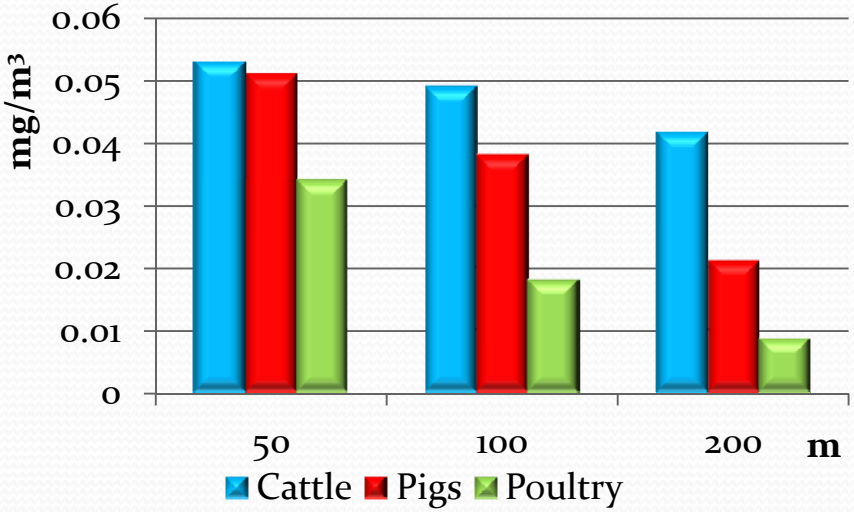
Assessment of ammonia emission reduction potential showed that technically feasible ammonia emission reduction in livestock husbandry amount about 20% of current emissions with abatement costs about 100 mln. Euro/year, which are twice as high as current annual air protection costs in Belarus.

Ammonia measurements in ambient air

Ammonia content in air of impact zones of different types of farms



Ammonia content in air at different distances from sources



A series of ammonia measurements in ambient air were made on the territory of livestock farms of different type and capacity and at different distance from sources of emission. Manual sampling was used.

Conclusions

Main results of ammonia emission investigation in Belarus:

- Inventory of sources of ammonia emission on the territory of Belarus was made;
- Sector and total emission estimates, spatially distributed including gridded emissions 50x50 km2 were prepared;
- Large point sources were allocated;
- Trends in ammonia emission were detected;
- First ammonia emission projection till 2020 was made;
- Ammonia measurements in ambient air near sources of ammonia emissions started;
- Ammonia emission abatement costs were assessed (first results).

Further steps:

- Spatially distributed emissions with higher resolution (by 10x10 km or by 0.1x0.1 degree);
- Impact assessment;
- Ammonia emission abatement scenarios and costs;
- Ammonia emission reduction plans;
- Improved projections (by 2030) etc.

Thank you for your attention!