Natural fertiliser control and application system in Poland – state of the art.

The natural manure composition in Poland – estimating and verification

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One of the priority actions taking part at the waters quality improving is standardizing the amounts of produced manures, and the amounts of biogenic substances they contain.

Standardizing activities were also pursued in Poland, based on research data, for medium and high intensive production.

The specificity of Polish animal production is a result of low concentration and profitability of production.

This specificity imply the need for verification of standards, using the data from direct monitoring in the whole of Poland.

Currently, it is over 10 million LU of all livestock species maintained in 1 million farms. Nearly 50% of Polish farms keeping livestock animals, maintains annually of up to 5 LU, and 40% of these farms – up to 2 LU. 57% of LFA.

The outdoor system for pigs.

Intensive pig farm.

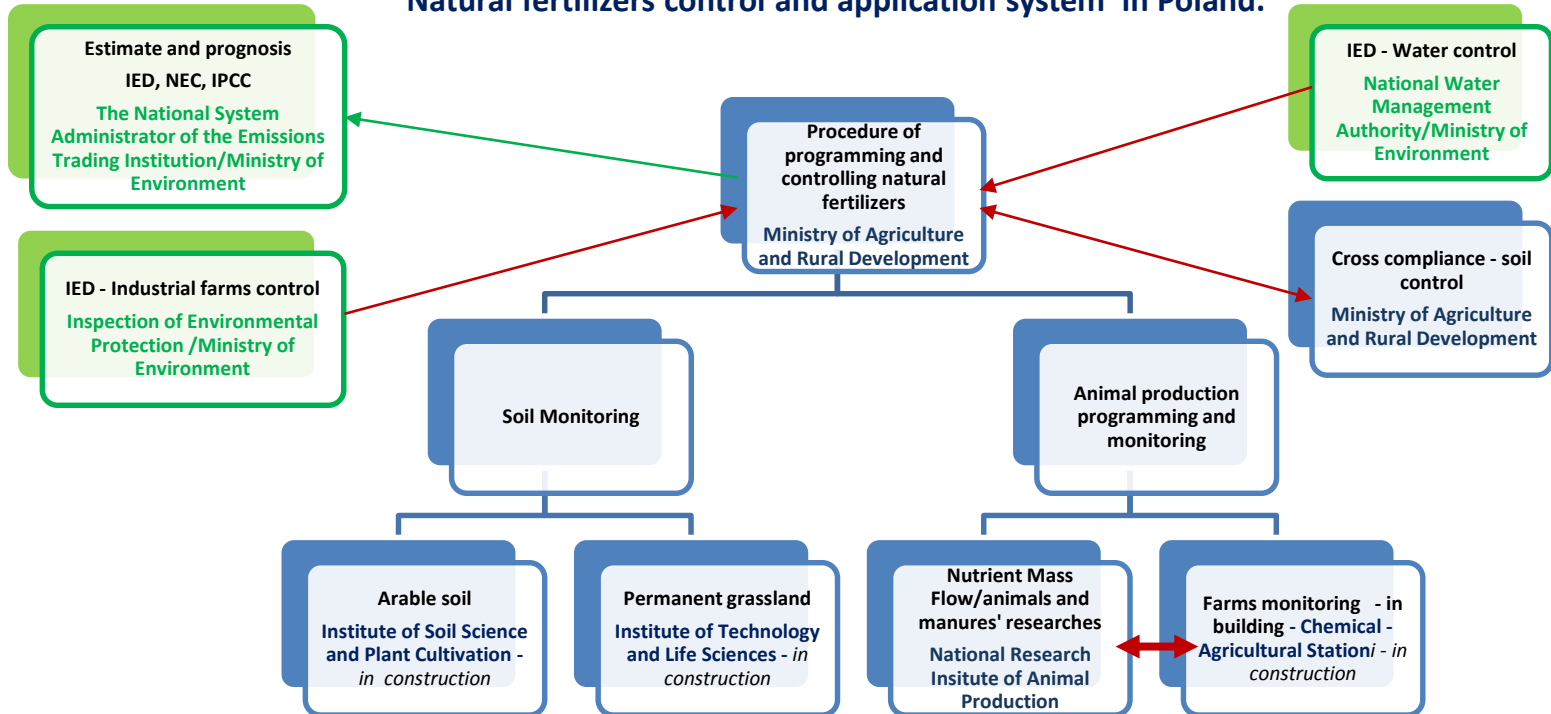Sheep of polish native breed in Tatra Mountains.

Changes in pig numbers in Poland, 2001-2011.

Number of farms ('000)	No. of pigs in drove						Production volume ('000 heads)
	1-9	10-49	50-199	200-399	400-999	≥1,000	
2001							
679	22.2	31.2	23.0	4.7	3.6	15.3	16,300
2011							
360	5.7	19.4	27.1	47.8			11,056

The Hereford beef on natural pasture in Bieszczady Mountains.

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Natural fertilizers control and application system in Poland.

Estimate and prognosis

IED, NEC, IPCC

The National System Administrator of the Emissions Trading Institution/Ministry of Environment

IED - Industrial farms control

Inspection of Environmental Protection /Ministry of Environment

Procedure of programming and controlling natural fertilizers

Ministry of Agriculture and Rural Development

IED - Water control

National Water Management Authority/Ministry of Environment

Cross compliance - soil control

Ministry of Agriculture and Rural Development

Soil Monitoring

Animal production programming and monitoring

Arable soil

Institute of Soil Science and Plant Cultivation - in construction

Permanent grassland

Institute of Technology and Life Sciences - in construction

Nutrient Mass Flow/animals and manures' researches

National Research Insitute of Animal Production

Farms monitoring - in building - Chemical - Agricultural Station*i - in construction*
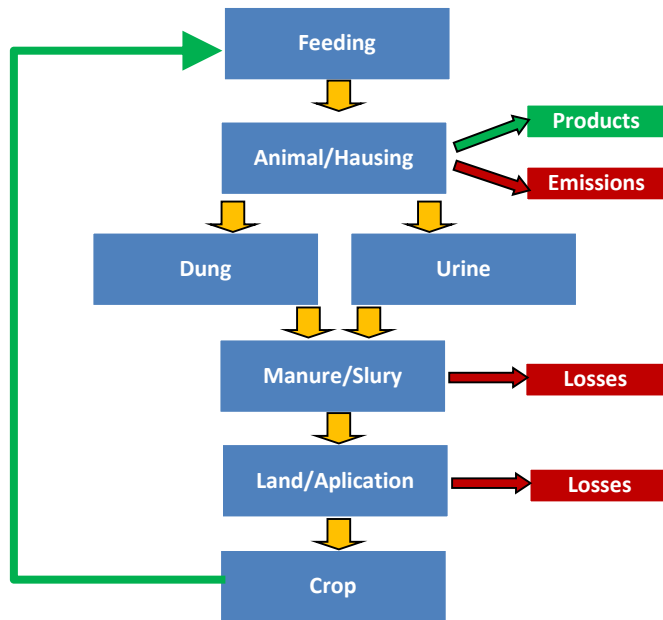
At the moment, a two-component natural fertiliser control and application system in Poland already exists. The first pillar comprises legal acts and control mechanisms for their implementation. Scientific research and agricultural advisory system creates the second pillar of the system.
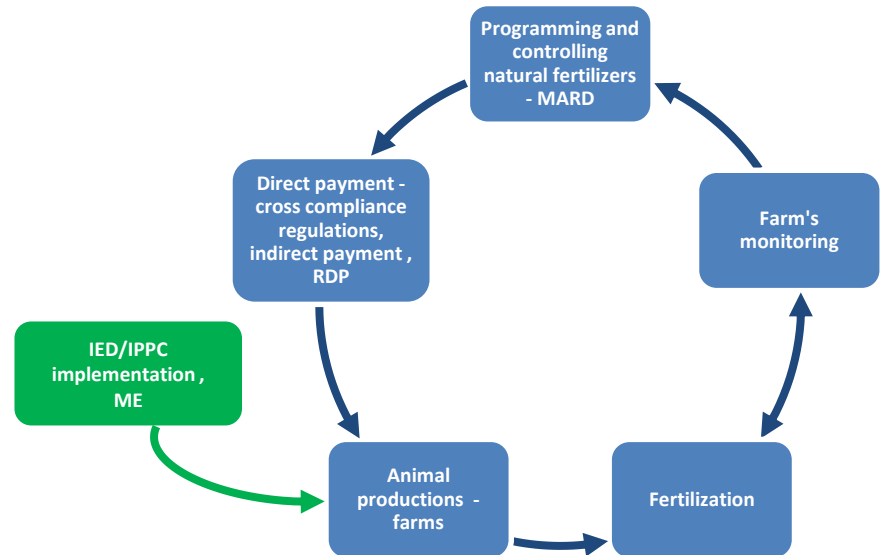
The logical setting of procedure for determining the composition of manures methodology, include the nutrient mass flow model.

The obtained standards of the amounts and concentrations of manures were adopted by the Ministry of Agriculture and Rural Development as indicators for farms.
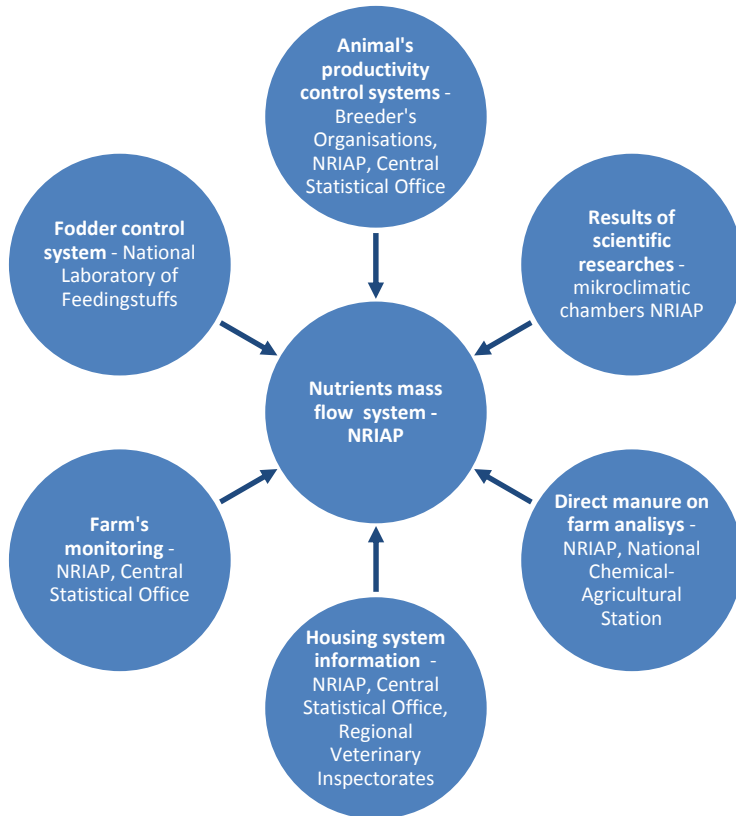

Functional scheme of fertilization standards implementation in practice

It stays fundamental for the received model to gain over the national animal production data based on representative sample. This requirement is fulfilled via data base in NRIAP constructed from many national, independent, official sources.

The obtained quantity and quality fertilizers' standards are not only theoretical but they are validated and calibrated with appropriate coefficients from monitoring.

Example of annual production of manures and the concentrations of nitrogen contained in them - NRIAP results.

Group of animals	HOUSING SYSTEM			
	Deep litter		Non-bedding/slurry	
	Production (t/year)	Content (kg/t)	Production (m³/year)[1.]	Content (kg/m³)
Bulls	19.0	3.1	22,0	3,5
Dairy cows 1[a]	18.8	2.6	17,6	3,4
Dairy cows 2[b]	23.8	3.1	23,0	4,0
Dairy cows 3[c]	26.0	3.7	25,4	4,5
Heifers in calf	18.4	3.0	16,4	3,4
Heifers ½ to 1 year	7.8	3.4	6,8	4,7
Calves < ½ year	2.4	3.8	2,6	3,2
Boars	5.5	3.1	4,6	3,6
Sows	5.0	3.9	4,6	4,3
Piglets	1.5	2.9	1,4	3,0
Weaners	0.5	1.8	0,7	2,0

Structure of data base sources in NRIAP nutrient mass flow system.

In 2002 and 2012, the NRIAP elaborated a study of the amounts of manures, and on the needs to store them, as well as on the concentrations of compounds.
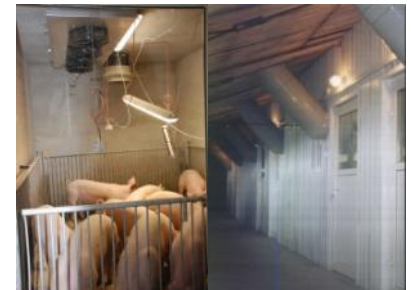
In scientific studies on the amounts of production and concentrations of manures, have drawn their starting point from the national average of:

✓ productivities (milk, meat, eggs),
✓ feeding regimes,
✓ numbers of stock animals,
✓ housing systems.

The data was verified by the field studies. Following the analyze, data was obtained on the amount of production of solid and liquid manures.

Main base of NRIAP Balice/Cracow.

The microclimate chambers in NRIAP.

Field study of manure – NRIAP.

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The practices applied to manure use in polish farms are very divergent. Thus, it was decided that the study of farms involving the practices applied in production, storing, and application of manures will be necessary.

The study will involve only representative portion on a country level. The exercise will use the stratified random sampling method.

The exercise will be performed in 2015 - 2017, including the part involving questionnaire studies focused on production data, and the part covering the analyses of manures in summer and winter.

Structure of agricultural holdings by area groups.

PL

1,8%
6,3%
36,7%
55,2%

- Less than 5ha
- 5-19 ha
- 20-49 ha
- 50 ha and more
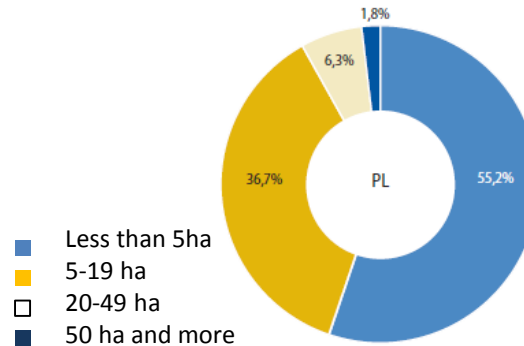
Trends in farm animal population in Poland.

Item (thousand heads)	Production volume	
	2002	2013
Cattle	5,532.7	5,589.5
including cows	2,873.2	2,441.9
Pigs	18,628.9	10,994.4
including sows	1,918.4	955.1
Poultry	198,783	129,122
Sheep	345.3	223.1
Horses	329.6	303.9
Goats	193.3	89.9
Female rabbits	870.4	630.0
Female fur animals	257.3	449.4
Bee colonies (thousand)	562.4	596.2

High frequency of extensive technologies – low profitability of production.

The free ranging of Hucul horses.

The deep litter for dairy cows.

Organic breeding of rabbits.

Poultry on the pasture.

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Typical manure storage.

Covered lagoon for slurry.

Verification methodology takes into account:
- ✓ animal species,
- ✓ production intensities,
- ✓ housing systems,
- ✓ storage methods,
- ✓ regional factor,
- ✓ feeding system.

$$\text{Nutrient use efficiency} = \frac{\text{Nutrient in animal product}}{\text{Nutrient in animal feed}}$$

Technological group of cows	Milk volume (l/year)	Feed input (dm kg/day)	Nutrient concentration (%/1 kg dm)		N output in manure - deep litter (kg/year)
			BO	MJ EM	
High productivity	10 000	18,28	16,5	6,9	96,2
Middle productivity	8 000	17,62	15,0	6,2	73,78
Low productivity	6 000	16,96	12,5	5,1	48,88

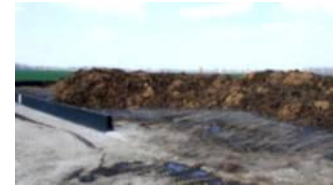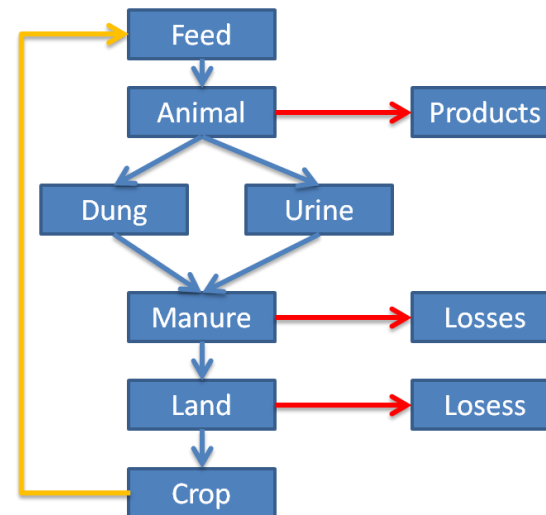The principal data concerning the sampling of natural manures:

Material: (dairy cattle, beef cattle, pigs, broiler chickens, laying hens).

Manure types – solid and liquid (slurry).

Systems – deep-litter, shallow-bedding, slurry.

Potential scope of analyses: (dry matter, total nitrogen, organic nitrogen, mineral nitrogen, ammonium nitrogen, nitrate nitrogen, organic phosphorus, mineral phosphorus, potassium, total carbon, organic carbon, C/N, pH).

Logical pad of verification methodology.

Feed → Animal → Products

Animal → Dung, Urine

Dung, Urine → Manure → Losses

Manure → Land → Losess

Land → Crop → Feed

The slurry injector.

Slurry separation.

The biogas plant.

Differences in manure storage = different concentration of contents.

Along with collection of samples in each farm there will be interviews and questionnaire studies, including the following items:

Location, size of herd, productivity of animals, pasturing, feed ration, summer/winter feed ratio, feed consumption, water consumption, % of fodder purchased, method of manure gathering, size of manure production, size of available storage tanks, methods of manure management, time of manure application, methods of manure application, amounts of mineral fertilizers used,

All the data obtained from the analysis will be entered into digital databases. These databases will enable processing of data and obtaining characteristics for particular species, cultivars, regions, etc.

Organic culture.

Analytical laboratory in INIRAP.

Analytical laboratory in INRIAP.

Pasture on the Natura 2000 area.

The lisymeter exercise.

Possibility of data base — Manure volume and concentration, Fertilization, NVZ, LFA, Productivity, Profitability, Feeding, Housing system

With all projected activities, a three-component system for determining the composition of manures in Poland shall be discovered and developed further.

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