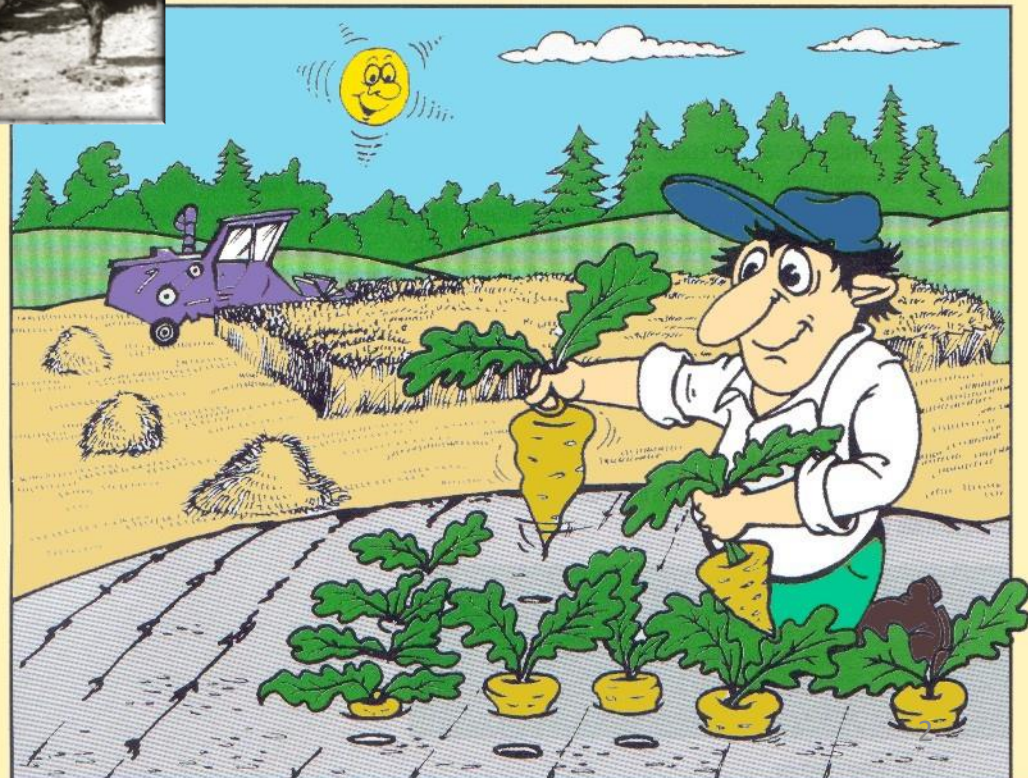
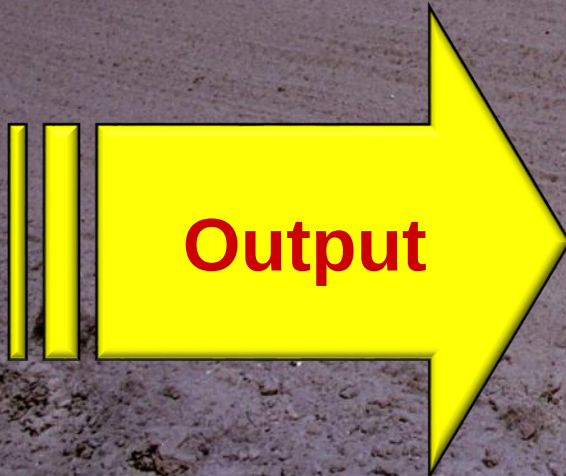
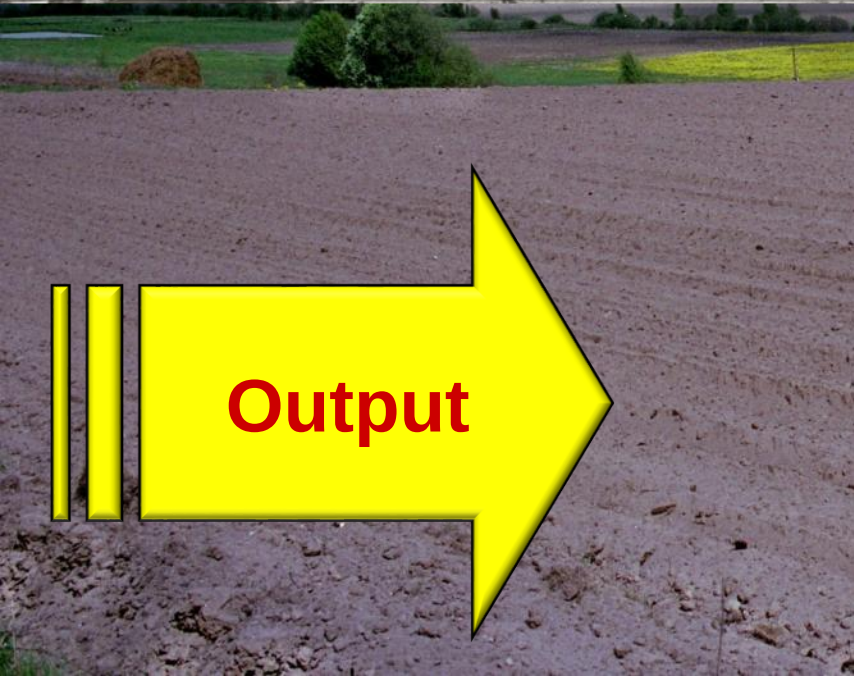
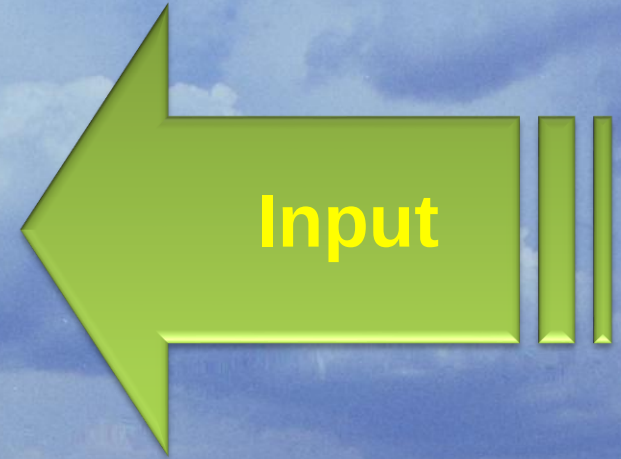


PLANT NUTRIENT BALANCES ON FARM LEVEL – LATVIA

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Objectives of presentation

- Still there is not strict requirement for farmers in Latvia to calculate plant nutrient balances annually and report these data.
- But many elements of balance approach are included in legislative acts, recommendation systems as well as used for fertilisation planning.
- The purpose of presentation – to show the development of legislative, methodological and organizing framework for plant nutrient balance calculations on farm level in Latvia.

Legislative framework

Cabinet Rules No. 834 Regulations on water and soil protection from agricultural activities due to pollution by nitrates (Nitrate Directive), December 23, 2014.

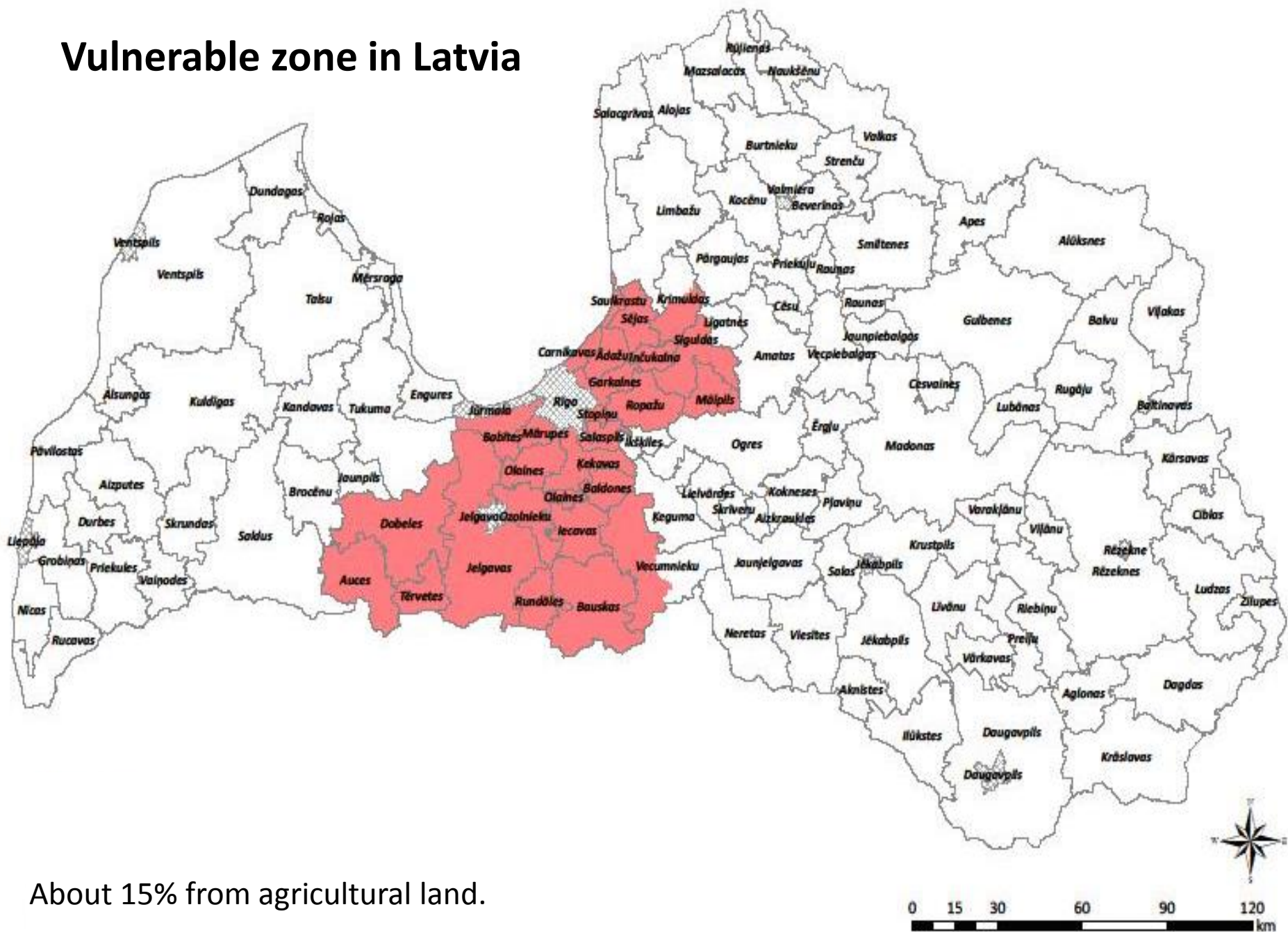
Accountancy of all livestock wastes (manure, digestate, composts etc.) produced, obtained or sold in (from) the farm and to keep such records for three years. Manure composition is specified using normative (reference) values, or farmer is able to send the manure samples to certified laboratory and to use these results in fertilising planning.

Manure output reference values

Example

Farm animals	Manure		Dry matter, %	Per one ton of manure, kg			Max. allowed use, t ha ⁻¹
	type	per year, t		N	P ₂ O ₅	K ₂ O	
Milking cows (<6000 kg milk)	Solid	13.0	20	5.4	2.6	3.9	31
	Liquid	17.0	10	4.1	1.4	2.8	41
Milking cows (6000 - 8000 kg milk)	Solid	15.0	20	5.9	3.2	5.3	29
	Liquid	19.0	10	4.2	2.1	2.9	40
Milking cows (>8000 kg milk)	Solid	20.0	20	6.0	2.9	4.3	28
	Liquid	26.0	10	4.4	2.2	3.3	39

Vulnerable zone in Latvia



About 15% from agricultural land.

Vulnerable zone in Latvia

Farms > 20 ha (field crops) or > 3 ha (potatoes, vegetables, orchards).

- Field history for every field of farm and keep them for at least three years.
- Records about obtained mineral fertilisers and its chemical composition (at least NPK content).
- Annual fertilisation plans and to send its summary to the State Plant Protection Service. The layout of Summary is standardised and information will be maintained using electronic data base.

Summary of fertiliser plan

	Parameters	Unit	Total	Applied		
				fall	spring	
1.	Agricultural land	ha	102	×	×	
2.	Fertilised area	ha	69	23	65	
3.	Manure	t	×	×	×	
3.1.	<i>Horse manure</i>	t	80	–	80	
3.2.	<i>Fattening pigs, solid manure</i>	t	30	30	–	
3.3.	<i>Compost (poultry manure + peat)</i>	t	75	–	75	
4.	Commercial fertilisers	t	×	×	×	
4.1.	<i>Ammonium nitrate</i>	t	7.5	–	7.5	
4.2.	<i>Ammonium sulphate</i>	t	8.0	–	8.0	
4.3.	<i>Single superphosphate</i>	t	12.5	–	12.5	
4.4.	<i>Compound 16–16–16</i>	t	12.0	4.6	7.4	
4.5.	<i>Potassium chloride</i>	t	10.0	–	10.0	
5.	Farm animals	gab.	×	×	×	
5.1.	<i>Hoerses</i>	gab.	8	×	×	
5.2.	<i>Fattening pigs (30 – 100 kg)</i>	gab.	20	×	×	
6.	Animal units	AU	5.44	×	×	
7.	Animal units per ha of agricultural land	AU/ha	0.05	×	×	
8.	Area required for application of manure	ha	3.2	×	×	8

Crops grown in farm

Summary of fertiliser plan

	Crop	Area, ha	Yield goal, t ha ⁻¹
1.	<i>Winter rye</i>	23.0	3.5
2.	<i>Potatoes</i>	7.5	30
3.	<i>Spring barley</i>	12.0	3.5
4.	<i>Oats</i>	7.3	3.0
5.	<i>Maize, green foliage</i>	19.2	45
6.	<i>Perrenial grassess (hay)</i>	20.0	6.0
7	<i>Pastures</i>	13.0	25

Methodology of balance calculation

Development of prototype within the project **Managing Inputs of Nutrients to Avoid Insufficient or Excess – MAINTAINE** (1999 – 2001). ADAS, Gleadthorpe Research Centre (UK) – coordinator, Institute of Soil Science and Plant Cultivation (Poland), Soil Science and Conservation Research Institute (Slovak Republic), Research Institute of Crop Production and Central Institute for Supervising and Testing in Agriculture (Czech Republic), Plant Research International (The Netherlands) and Latvia University of Agriculture.

NPK Soil surface balance

Variables	N	P ₂ O ₅	K ₂ O
Input, kg			
1.1. Manure produced in farm (A)			
1.2. Manure purchased (B)			
1.3. Commercial fertilisers (C)			
1.4. Biological nitrogen fixation (D)			
1.5. Seeds and planting material (E)			
Output, kg			
2.1. Removal by yield (G)			
Results			
Balance per farm, kg: $(A+B+C+D+E)-G = S$			
Balance per ha, kg: S/area			
Balance intensity, %			

NPK Farm gate balance

Variables	N	P ₂ O ₅	K ₂ O
Input, kg			
1.1. Commercial fertilisers (A)			
1.2. Purchased seeds and planting material (B)			
1.3. Purchased animals (C)			
1.4. Purchased feed (D)			
1.5. Purchased organic manures (E)			
1.6. Biological nitrogen fixation (F)			
Output, kg			
2.1. Crop products sold (G)			
2.2. Animal products sold (H)			
2.3. Losses from animal operations			
Results			
Balance per farm, kg: $(A+B+C+D+E+F)-(G+H+I) = S$			
Balance per ha, kg: S/area			

Project activities

- Development and unification of reference values.
- Adaptation and validation – 5 year studies in 6 model farms.
- Publications.
- Seminars, demonstration.

Gross Nutrient Balances, 2009

EUROSTAT Pilot studies.

- Adaptation of OECD/Eurostat Gross Nitrogen Balance methodology and development of reference values catalog.
- NPK balance calculation for the year 2008 for all utilised agricultural land of Latvia in average as well as separately for each of 6 regions of country.

NPK balance, kg ha⁻¹, 2008

Parameters	Zemgale			Latgale		
	N	P ₂ O ₅	K ₂ O	N	P ₂ O ₅	K ₂ O
Input						
Mineral (commercial) fertilizers	49.83	16.51	21.72	9.55	3.02	3.41
Organic fertilizers	5.50	4.01	5.56	5.13	3.62	4.72
Symbiotic N fixation	3.48	×	×	4.32	×	×
Non-symbiotic N fixation	3.62	×	×	4.48	×	×
N deposition	6.00	×	×	6.00	×	×
Seeds and planting material	2.29	0.97	1.39	1.16	0.51	0.77
Total input	70.72	21.49	28.67	30.65	7.15	8.91
Output	71.51	28.72	69.27	33.33	12.09	36.52
Balance	-0.79	-7.22	-40.60	-2.68	-4.94	-27.61
Balance intensity, %	99	75	41	92	59	24

NP content in agricultural products

Development of coefficients necessary for the Nutrient Budget calculations, EUROSTAT 2013.

1. Development of scientifically-based methodology and technical solutions for determination of nitrogen and phosphorous content in the harvested crops, considering the climatic conditions, production system, management and other measures ensuring the comparability of the Gross Nutrient Budget (GNB) at international level, including compatibility of data by time period.

NP content in agricultural products

2. Development of scientifically-based methodology and technical solutions for calculation of harvested by-products of crops of a national significance and N and P content thereof.
3. Calculation of missing N and P content coefficients and re-calculation of existing coefficients, basing on the latest scientific researches in this field, as well as conduction of additional researches, if necessary.
4. Comparison with similar experiences and practices described in studies of other international experts and evaluation of possibilities for their use under Latvia conditions.

Share of individual crops in NP budgets in Latvia, %

Crops, products	Share, % from the total NP budget	
	N	P ₂ O ₅
Cereals	44.752	47.530
Winter wheat, grain	25.278	25.239
Spring wheat, grain	7.618	8.055
Spring barley, grain	4.690	5.933
Spring oats, grain	2.345	2.160
Pulses	0.475	0.418
Potatoes	1.677	1.689
Industrial crops	9.861	14.973
Winter oilseed rape, seeds	6.012	9.659
Spring oilseed rape, seeds	3.804	5.272
Fodder crops	32.815	27.118
Perennial grasses, hay	14.717	11.506
Perennial grasses, green forage	15.075	11.759
Maize, green forage	2.105	3.050
Pastures and meadows	10.180	7.909
For hay	5.866	4.519
For green forage	4.314	3.390
Vegetables	0.350	0.350
Orchards	0.008	0.012

Plant nutrient removal – *Example*

Crops	Yield	DM,%	Ratio	kg per ton		
				N	P ₂ O ₅	K ₂ O
Winter wheat	Grain	86		18.9	6.8	4.1
	Straw	80		4.6	1.4	9.6
	Grain+straw		1.1	23.9	8.3	14.7
Winter wheat (protein > 13.5%)	Grain	86		23.5	6.8	4.1
	Straw	80		4.6	1.4	9.6
	Grain+straw		1.1	28.5	8.3	14.7
Rye	Grain	86		15.0	7.4	5.1
	Straw	80		5.2	2.0	9.1
	Grain+straw		1.2	21.3	9.8	16.0
Winter barley	Grain	86		17.5	8.0	5.8
	Straw	80		5.0	1.8	15.1
	Grain+straw		1.0	22.5	9.8	20.9
Spring wheat	Grain	86		21.8	8.3	5.0
	Straw	80		6.0	2.1	9.8
	Grain+straw		1.0	27.8	10.4	14.7
Spring barley	Grain	86		18.1	8.2	5.2
	Straw	80		6.5	2.5	14.8
	Grain+straw		1.0	24.6	10.8	20.0

Fertiliser recommendations, 2013

Lauku kultūraugu mēslošanas normatīvi

Sastādītāji A. Kārklīšs un A. Ruža



All together 26 crops or crop groups was included. Crop nutrient requirement was shown on 20 tables each of them was made by two parts: recommended nutrient supply and corresponding NPK balance (supply minus removal). If applicable, balance was shown for situation when only main product is removed from the field, or – both, the main and the by-product removed.

Winter barley, winter triticale

Grain yield, t/ha	Removal, kg/ha			Plant nutrient requirement, kg/ha								
				N	Phosphorous, P ₂ O ₅				Potassium, K ₂ O			
	N	P ₂ O ₅	K ₂ O		P in soil				K in soil			
					VL, L	M	H	VH	VL, L	M	H	VH
3.0				75	60	40	35	10	70	60	50	30
4.0				95	80	50	45	20	80	65	60	35
5.0				105	—	70	55	35	100	70	65	40
6.0				125	—	90	65	45	—	75	70	50
7.0				140	—	—	75	60	—	—	80	60
	By grain			Balance (fertilisers – offtake by grain), kg/ha								
3.0	50	27	16	25	33	13	8	-17	54	44	34	14
4.0	67	36	21	28	44	14	9	-16	59	44	39	14
5.0	84	45	27	21	—	26	11	-10	73	43	38	13
6.0	101	53	32	25	—	37	12	-8	—	43	38	18
7.0	117	62	37	23	—	—	13	-2	—	—	43	23
	Grain + Straw			Balance (fertilisers – offtake by grain and straw), kg/ha								
3.0	61	28	48	14	32	12	7	-18	22	12	2	-18
4.0	81	37	64	14	43	13	8	-17	16	1	-4	-29
5.0	102	47	80	4	—	23	8	-12	20	-10	-15	-40
6.0	122	56	96	3	—	34	9	-11	—	-21	-26	-46
7.0	142	65	112	-2	—	—	10	-5	—	—	-32	-52

Organizing framework

- Not strict requirement for farmers to do plant nutrient balances systematically. Some of them are doing on voluntary basis.
- Usually the shortage of programs developed internationally – they are not adapted and validated to the Latvia situation and are not running using our local experimental data.
- Methodological framework for balance calculation is sufficient and it is possible to realize it on the routine basis.
- Political initiative, administrative measures and possible developments should be discussed.

**Thanks for
attention**

