



# Nitrate-N residues, soil mineral N balance and N fertilizer recommendation in vegetable fields in Flanders

***Mia Tits, Annemie Elsen,  
Hilde Vandendriessche and Jan Bries***

*Soil Service of Belgium*

*W. de Croylaan 48,  
3001 Heverlee, Belgium*

[www.bdb.be](http://www.bdb.be)



# Nitrate-N residues, soil mineral N balance and N fertilizer recommendation in vegetable fields in Flanders

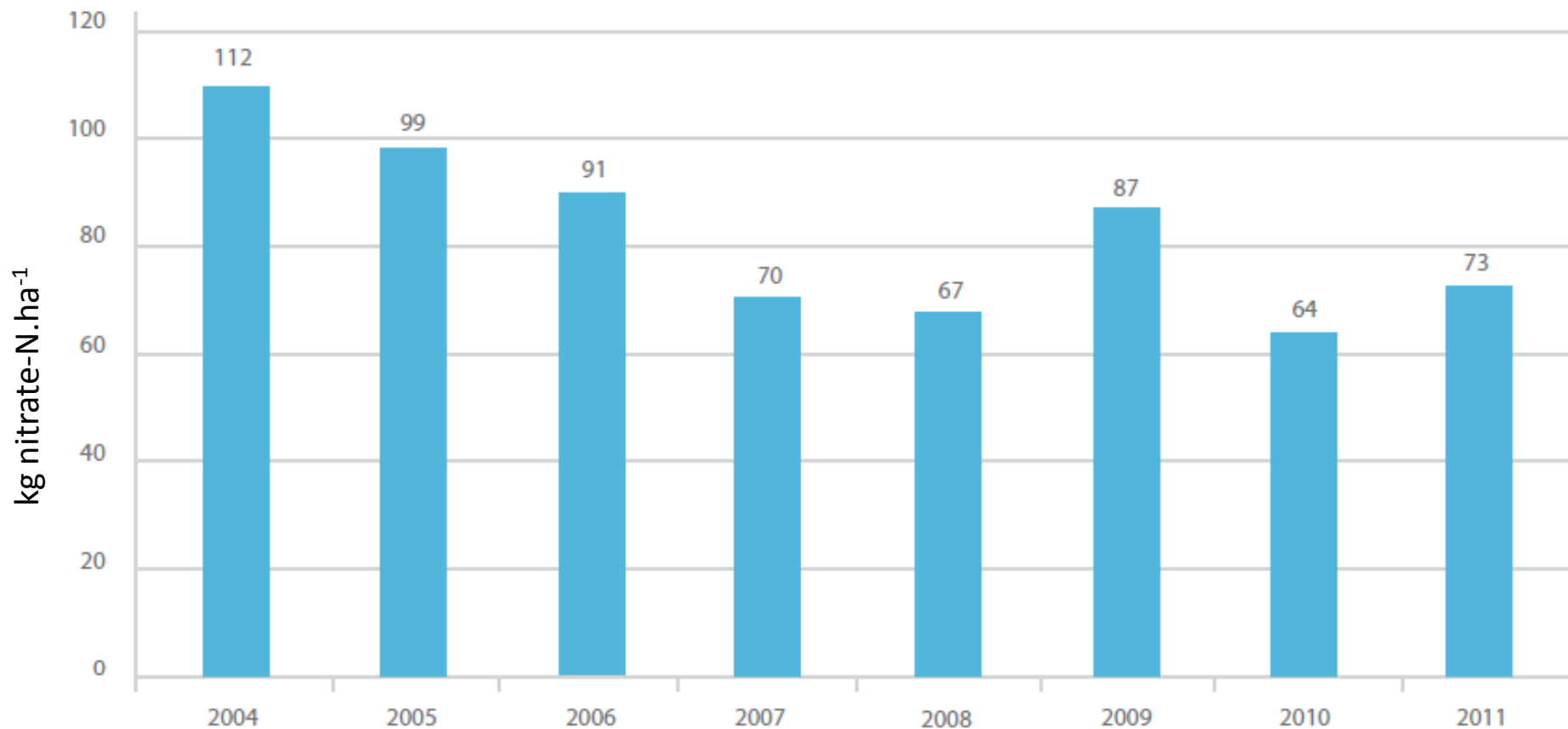
## **Definition:**

### Nitrate-N residue

- = residual nitrate-N in the soil (0-90 cm) in autumn
- = measured during the period from 1/10 – 15/11
- = expressed as kg nitrate-N per hectare
- = direct link with risk of nitrate leaching to ground- and surface water during winter



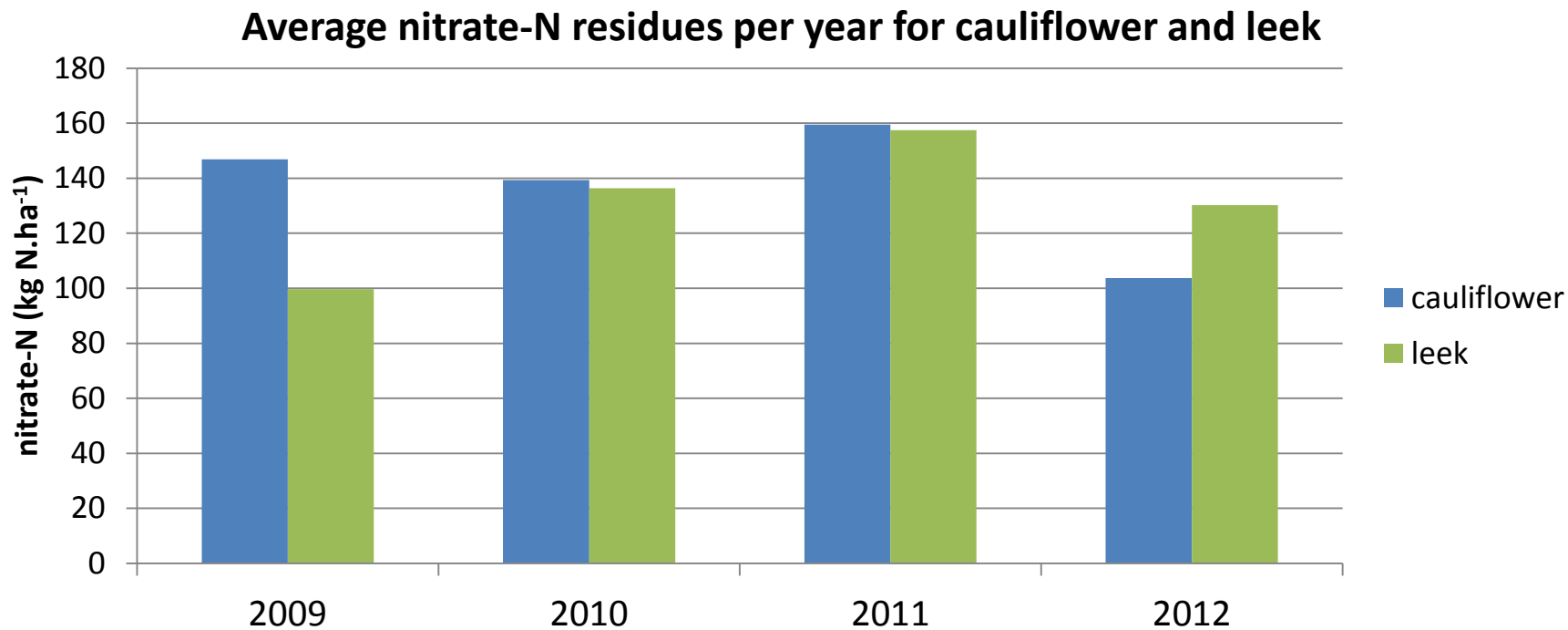
# Evolution of the nitrate N residues in agricultural crops in Flanders



Evolution of the weighted average nitrate-N-residue in Flanders based on the results of control measurements performed by the Manure Bank (VLM 2012)



# Evolution of the nitrate N residues in vegetable crops in Flanders

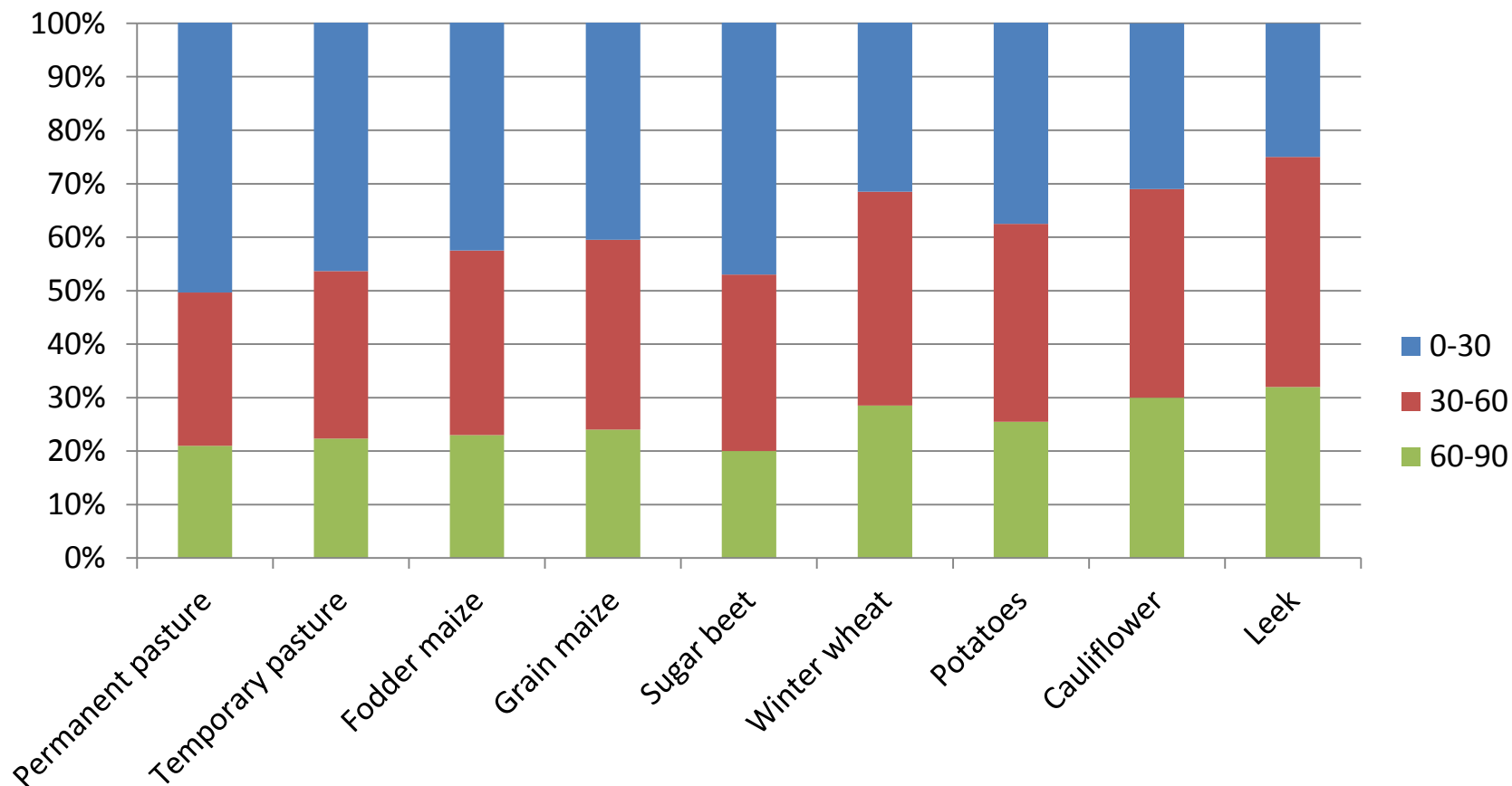


source: Soil Service of Belgium



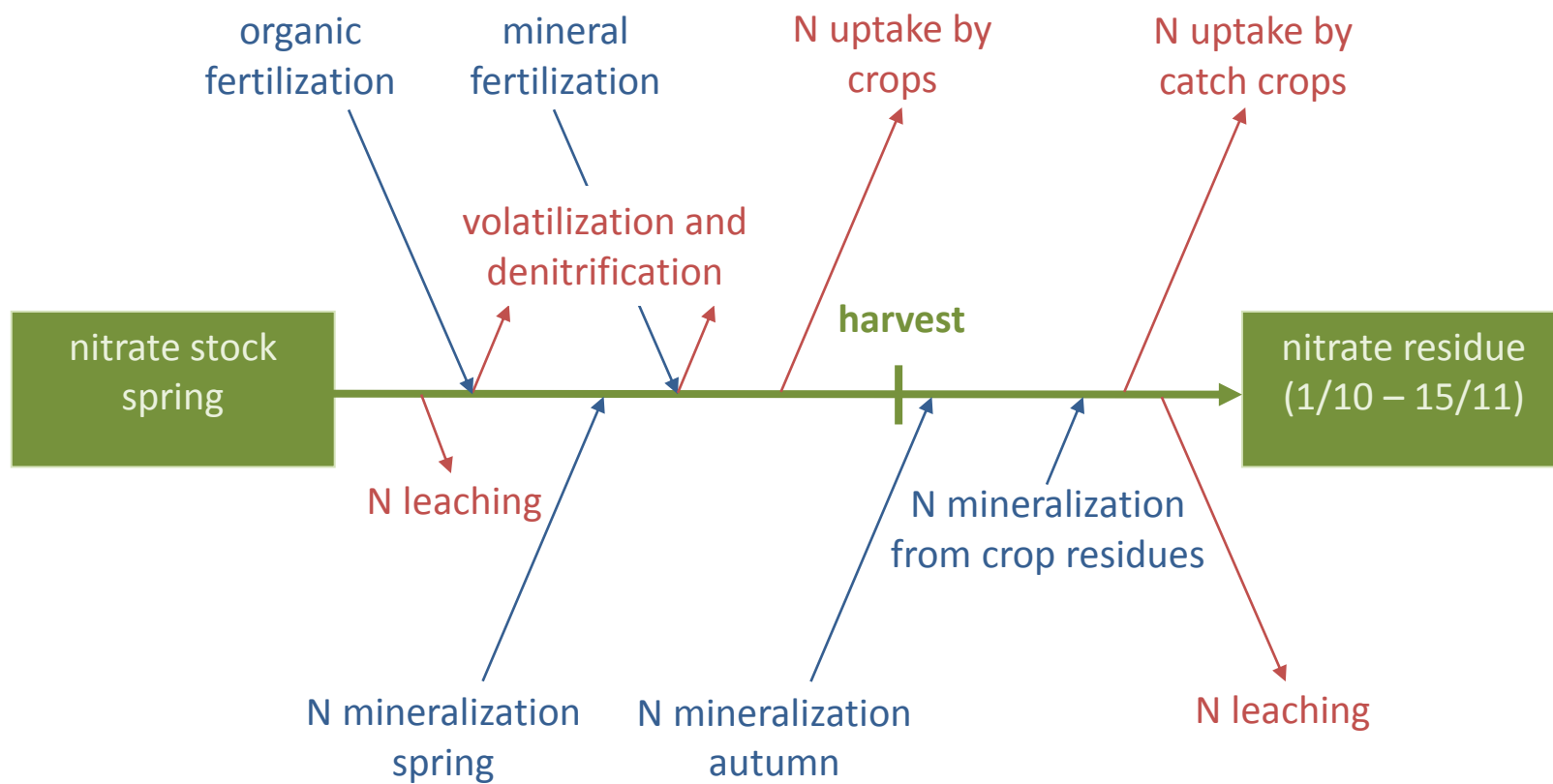
# Distribution of nitrate-N residues in the soil profile

**Distribution of the residual nitrate-N in the soil profile, per crop (VLM 2010)**





# Nitrate residue, influenced by many factors





# N-fertilization using the N-index method

## 1. N-requirements



**2. N-index** → N-availability during cropping season, depending on crop and parcel characteristics



+ N-stock (~rooting depth)

+ mineralization:

- OM (%C)
- green manure
- crop residue
- organic fertilizer

- effect soil texture/structure, low pH

- leaching during cropping season



# N-fertilization using the N-index method

## 1. N-requirements



**2. N-index** → N-availability during cropping season, depending on crop and parcel characteristics



## 3. N-advice



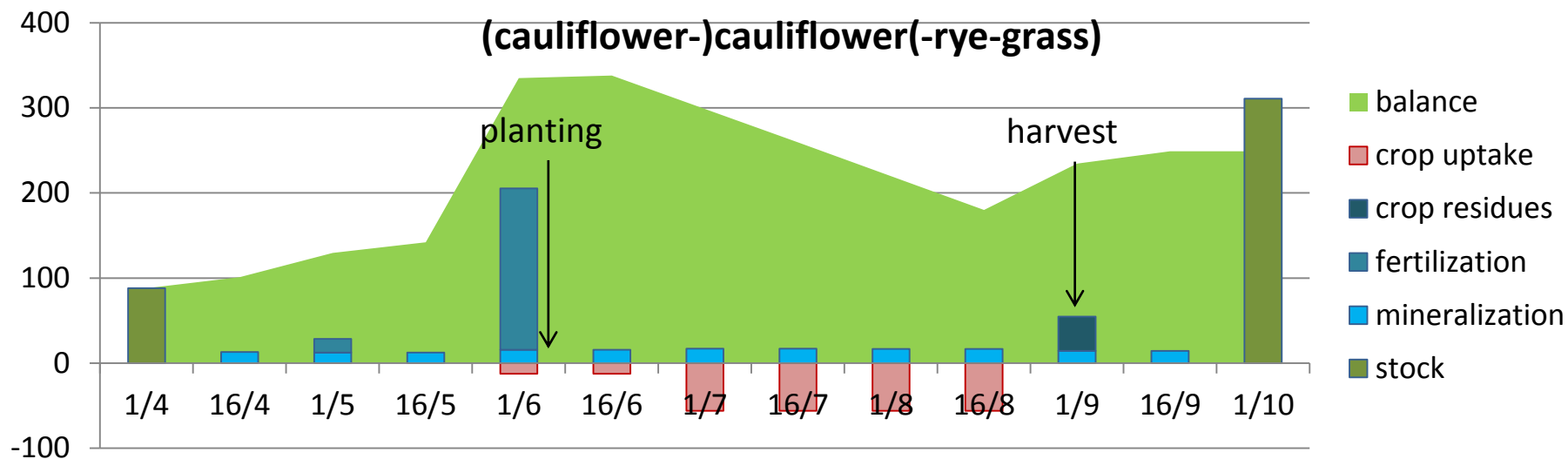


# Calculation of the soil mineral N balance

N inputs	N outputs
Mineral N stock in the soil profile (0-90 cm)	N uptake by crops
Expected N mineralization from soil organic matter	N uptake by catch crops
Expected N mineralization from crop residues	N losses through leaching
Applied mineral N fertilization	
N supply from applied organic fertilization	
Total input (incl. N stock)	Total output
	Expected residue (input-output)
	Nitrate-N residue
	Balance deviation



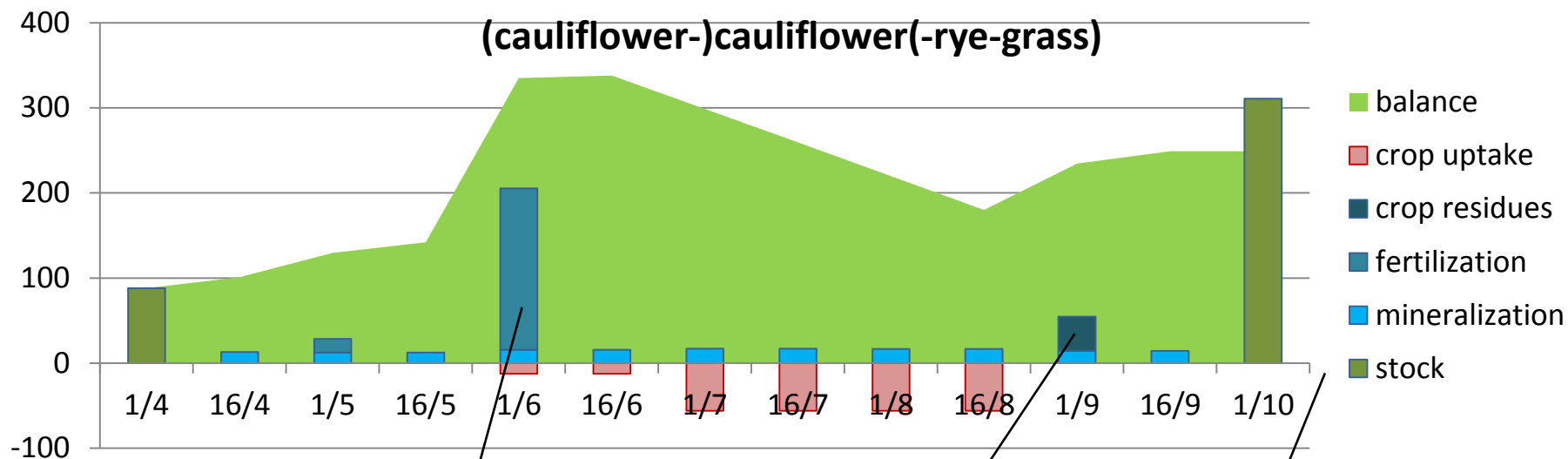
# Soil mineral N balance – case 1



N inputs	kg N.ha <sup>-1</sup>	N outputs	kg N.ha <sup>-1</sup>
Mineral N stock in the soil profile (April)	88	N uptake by crops	250
Expected N mineralization from soil organic matter	165	N uptake by catch crops	0
Expected N mineralization from crop residues	40	N losses through leaching	0
Applied mineral N fertilization	190		
N supply from applied organic fertilization	16		
<b>Total input (incl. N stock)</b>	<b>499</b>	<b>Total output</b>	<b>561</b>
		Expected residue (input-output)	249
		Nitrate-N residue (September 27 <sup>th</sup> )	311
		Balance deviation	-62



# Soil mineral N balance – case 1



excessive N fertilization of 190 kg N.ha<sup>-1</sup>  
(advice: 145 kg N.ha<sup>-1</sup>)

mineralization of N-rich  
crop residues in september

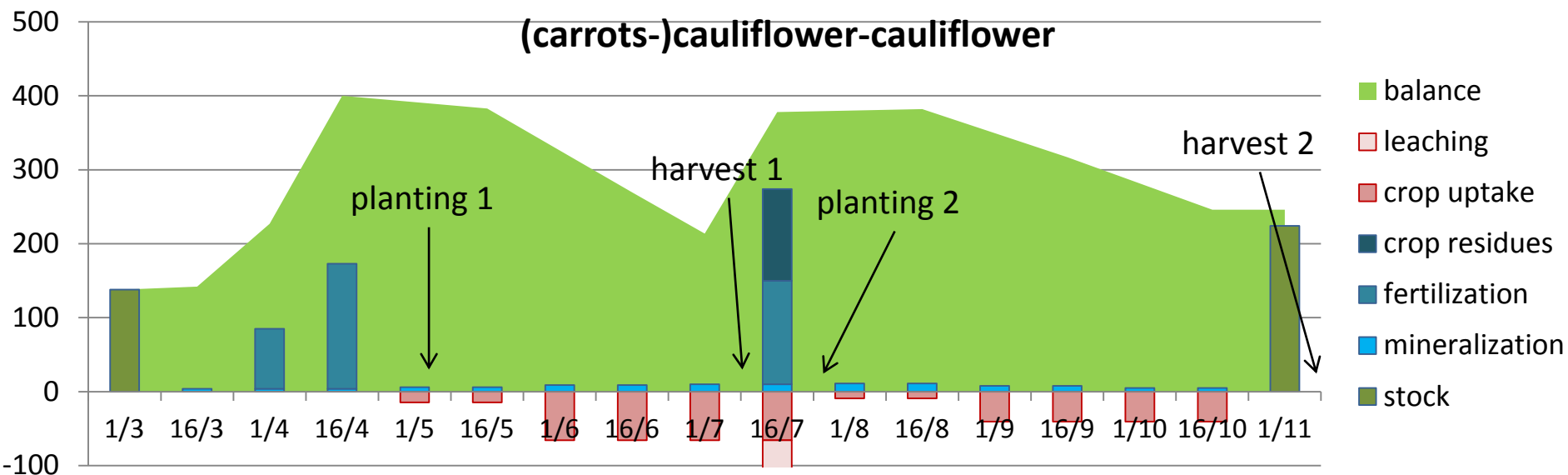
late N-uptake by  
catch crop rye-grass

**high nitrate-N residue**



# Soil mineral N balance – case 2

(carrots-)cauliflower-cauliflower

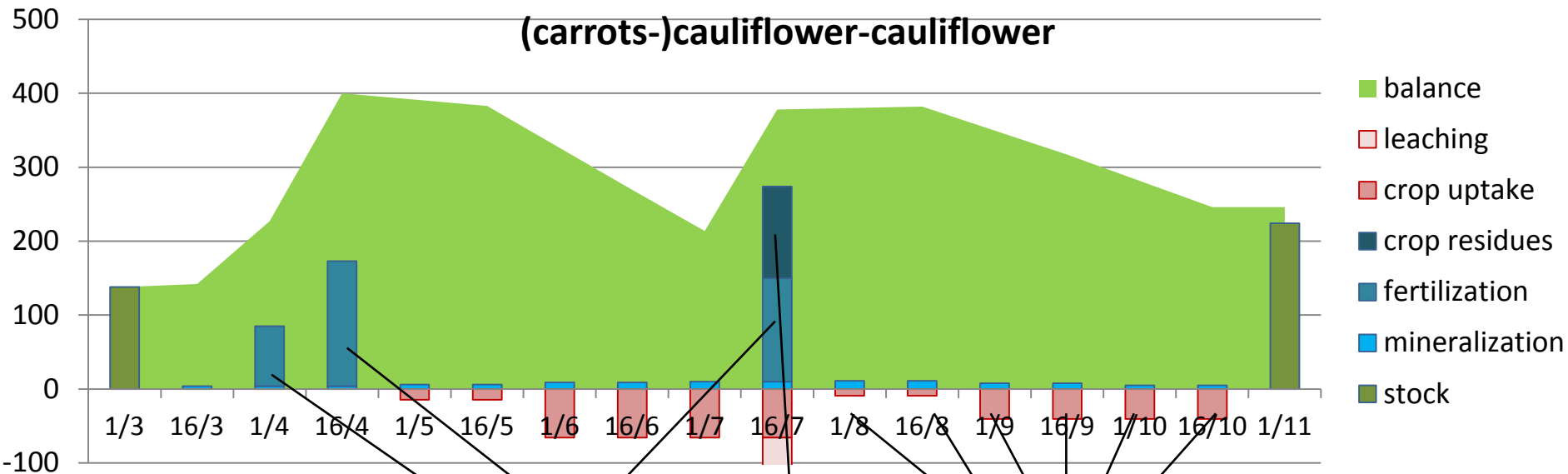


N inputs	kg N.ha <sup>-1</sup>	N outputs	kg N.ha <sup>-1</sup>
Mineral N stock in the soil profile (April)	138	N uptake by crops (292+180)	472
Expected N mineralization from soil organic matter	110	N uptake by catch crops	0
Expected N mineralization from crop residues	124	N losses through leaching	44
Applied mineral N fertilization (169+140)	309		
N supply from applied organic fertilization	81		
<b>Total input (incl. N stock)</b>	<b>762</b>	<b>Total output</b>	<b>739</b>
		Expected residue (input-output)	247
		Nitrate-N residue (September 27 <sup>th</sup> )	224
		Balance deviation	23



# Soil mineral N balance – case 2

(carrots-)cauliflower-cauliflower



excessive N fertilization for both crops (81+169 & 140 kg N.ha<sup>-1</sup>) (advice: 169 & 112 kg N.ha<sup>-1</sup>)

lower N-uptake by second crop (unfavourable conditions)

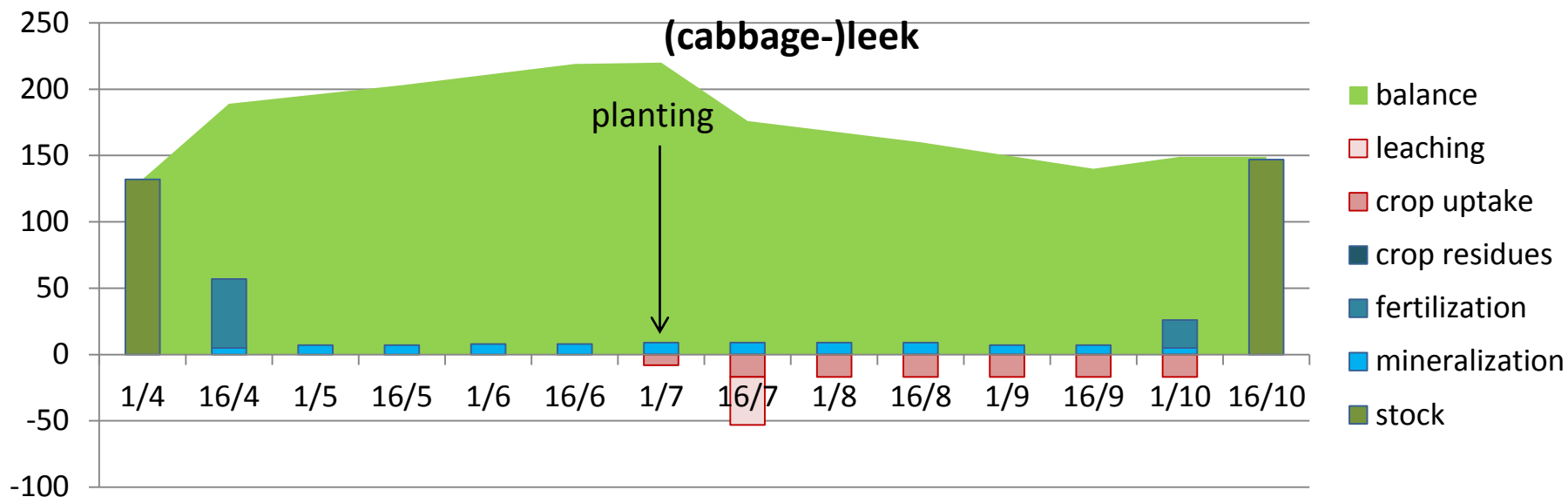
important N-supply from residues of first crop

late harvest, no catch crop

**high nitrate-N residue**



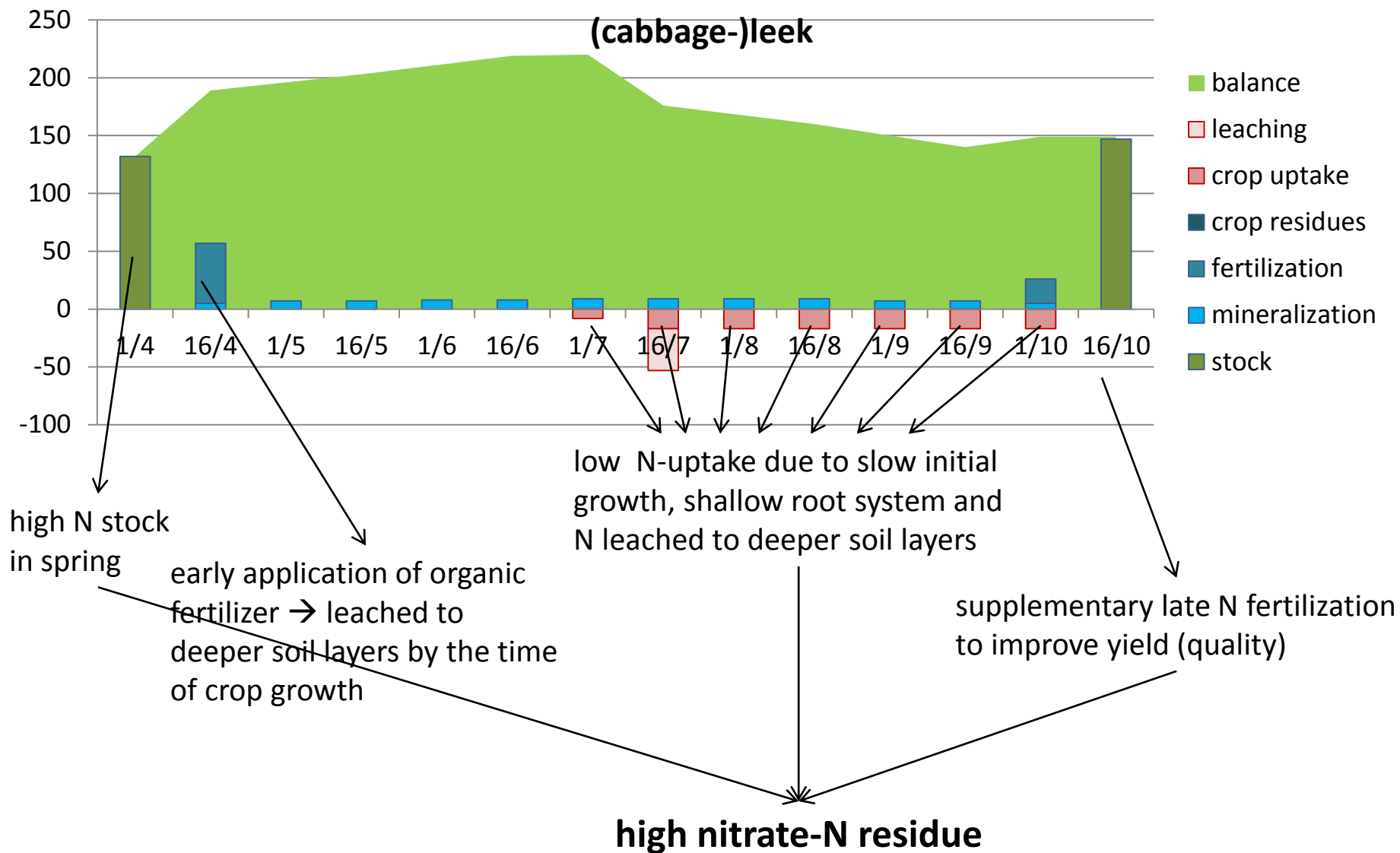
# Soil mineral N balance – case 3



N inputs	kg N.ha <sup>-1</sup>	N outputs	kg N.ha <sup>-1</sup>
Mineral N stock in the soil profile (April)	132	N uptake by crops	110
Expected N mineralization from soil organic matter	90	N uptake by catch crops	0
Expected N mineralization from crop residues	0	N losses through leaching	36
Applied mineral N fertilization	21	Nitrate-N residue (September 27 <sup>th</sup> )	147
N supply from applied organic fertilization	52		
Total input (incl. N stock)	296	Total output (incl. residue)	293
		Expected residue (input-output)	149
		Balance deviation	2



# Soil mineral N balance – case 3





# Conclusions

Major **bottlenecks** of vegetable growing in terms of nitrate residue:

- considerable amount of rapidly degradable crop residues
    - high N mineralization in a short period after harvest
  - shallow root systems, N in deeper soil layers is not absorbed
    - N distribution in soil profile very important
    - N availability at right time very important
    - N uptake seriously affected by weather conditions
  - late harvest in vegetative stage requires sufficient N supply
  - sowing of catch crop often practically impossible
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- Importance of **accurate N-fertilization** (dose and timing)
  - N fertilization recommendations based on
    - crop requirements,
    - soil analysis,
    - knowledge about mineral N becoming available during the growing season.
  - Soil mineral N balance = helpful tool