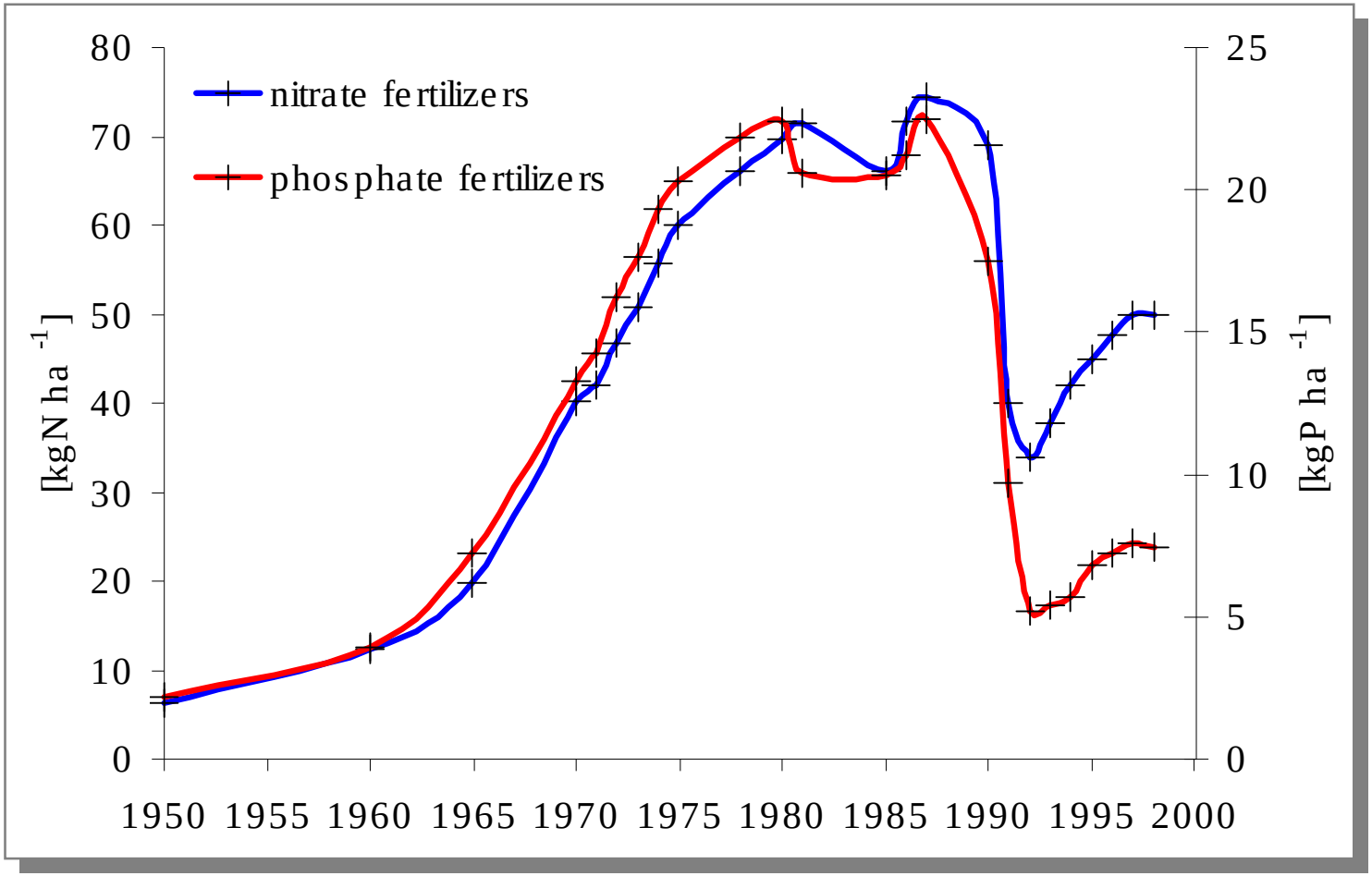

# SCENARIOS OF WATER QUALITY CHANGES IN THE VISTULA LAGOON BASIN

ANDRZEJ LEWANDOWSKI

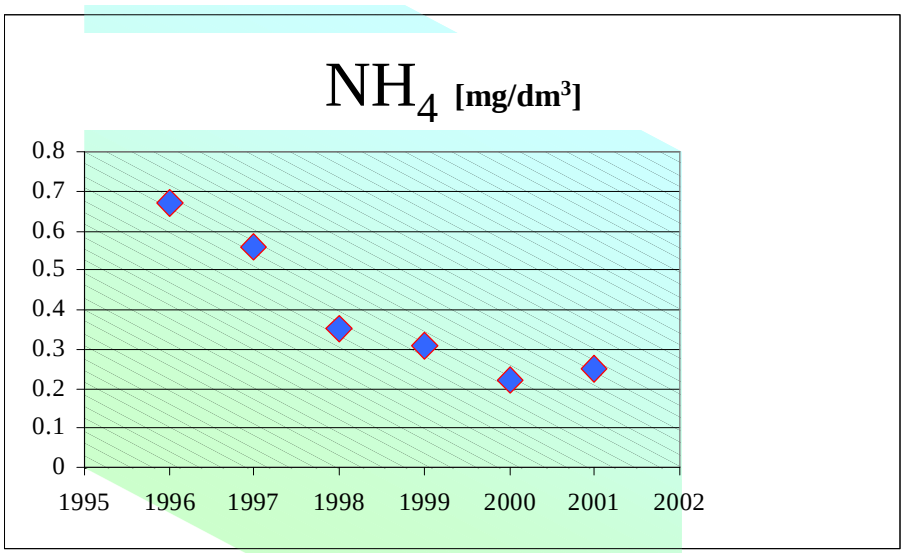
# CONSUMPTION OF COMMERCIAL FERTILIZERS IN POLAND

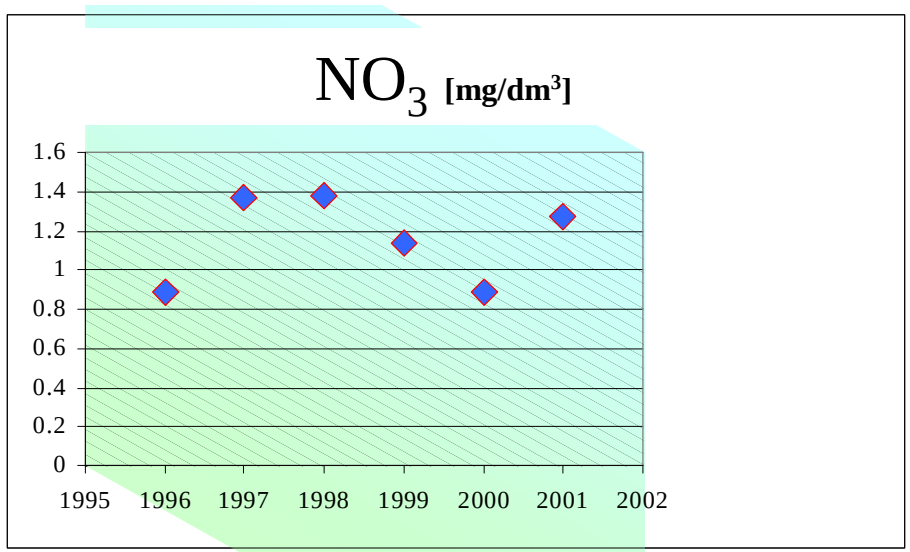


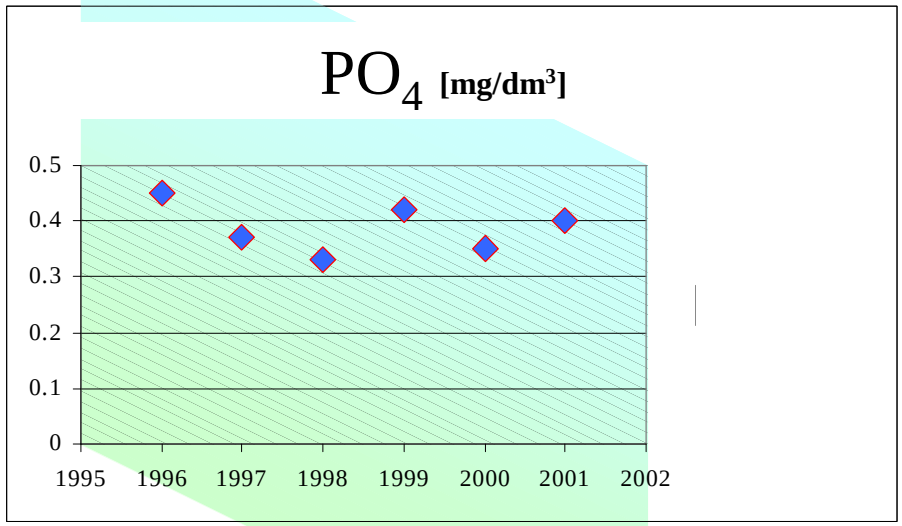

***Source:***

Pastuszak M., Wielgat M., and Sitek S. 2001. Nutrient status in the Szczecin Lagoon – past, present and future prospects. Oceanological Studies, 30 (1-2): 59-86 (after GUS. 1951-1998. Central Statistical Office (GUS) Annual Reports from years 1951-1998. C

# THE STATE MONITORING PROGRAMME RESULTS AT NOWA PASLEKA



# S C E N A R I O 01

## CRISIS SCENARIO

**PRESENT STATE BASED ON STATISTICAL DATA ON COMMUNE LEVEL IN 1996 (+ UPDATE FOR 2002)**

Existing level of point sources nutrient pollution load

Existing level of non-point pollution nutrient load based on following analysis:

- Existing agricultural practices:

manure storage on bare soil, solid manure applied in autumn, leaky and insufficient urine tanks, straw burning,

- Existing crop characteristic and yield:

Polish part: main crops are cereals – mean yield is 27 dt/ha (based on statistical data)

Russian part: main crops are cereals – mean yield is 19.3 dt/ha

- Existing animal production – 0.4 AU/ha at both countries
- Existing level of mineral fertilizer use (based on statistical data):

Polish part: NPK – 96 kg/ha (N – 52.87 kg/ha, $P_2O_5$ – 18.85 kg/ha, $K_2O$ – 24.29 kg/ha);

Russian part: NPK – 76 kg/ha (N – 52.87 kg/ha, $P_2O_5$ – 18.85 kg/ha, $K_2O$ – 24.29 kg/ha);

- Existing level of organic fertilizers use:

Polish part: manure -290 dt/ha (29 t/ha), urine - 9.8 $m^3$/ha (based on result of questionnaires from Pasłęka sub-catchments)

Russian part: manure – 200 dt/ha (20 t/ha), urine - ? $m^3$/ha

# S C E N A R I O 01

## CRISIS SCENARIO

| [t/year] | Direct point sources | | ‘Indirect’ point source load | Diffuse load within rivers load |
|---|---|---|---|---|
| | collector | Polish WWTP | | |
| **N load** | **2031.60** | **800** | **4080.93** | **7578.88** |
| **P load** | **135.24** | **160** | **404.80** | **217.97** |

# S C E N A R I O 02

## TARGET DEVELOPMENT

**WORST CASE: THE SCENARIO IS BASED ON THE ASSUMPTION THAT AFTER ENTERING EU POLISH AND RUSSIAN FARMERS WILL BE UNDER THE PRESSURE OF RISING THE PRODUCTIVITY. THEREFORE THEY WILL USE MORE FERTILIZERS FROM THE VERY BEGINNING BUT WILL NOT CHANGE SO FAST THEIR PRACTICES (ACCORDING TO ACCESSION TREATY THERE WILL BE SOME TRANSITIONAL PERIODS FOR POLISH FARMERS)**

### Decrease of point sources load (new and modernized waste water treatment plants - WWTP)

Polish part – Elblag (r. Elblag), Kwidzyn, Malbork, Sztutowo (r. Nogat), Braniewo, Paslek (r. Pasleka), Frombork (directly to VL).
Russian part – Kaliningrad

### Increase of non-point sources load:

- Existing agricultural practices (as describe above)
- Increase of crop yield up to UE level (typical farming region) – 78 dt/ha (mean value for Denmark)
- Increase of crop yield: fertilizers use 300 kg/ha (150 kg – N, $P_2O_5$ – 65 kg, $K_2O$ – 85 kg)
- Increase of animal production up to 1.5 AU/ha

# S C E N A R I O 02

## TARGET DEVELOPMENT

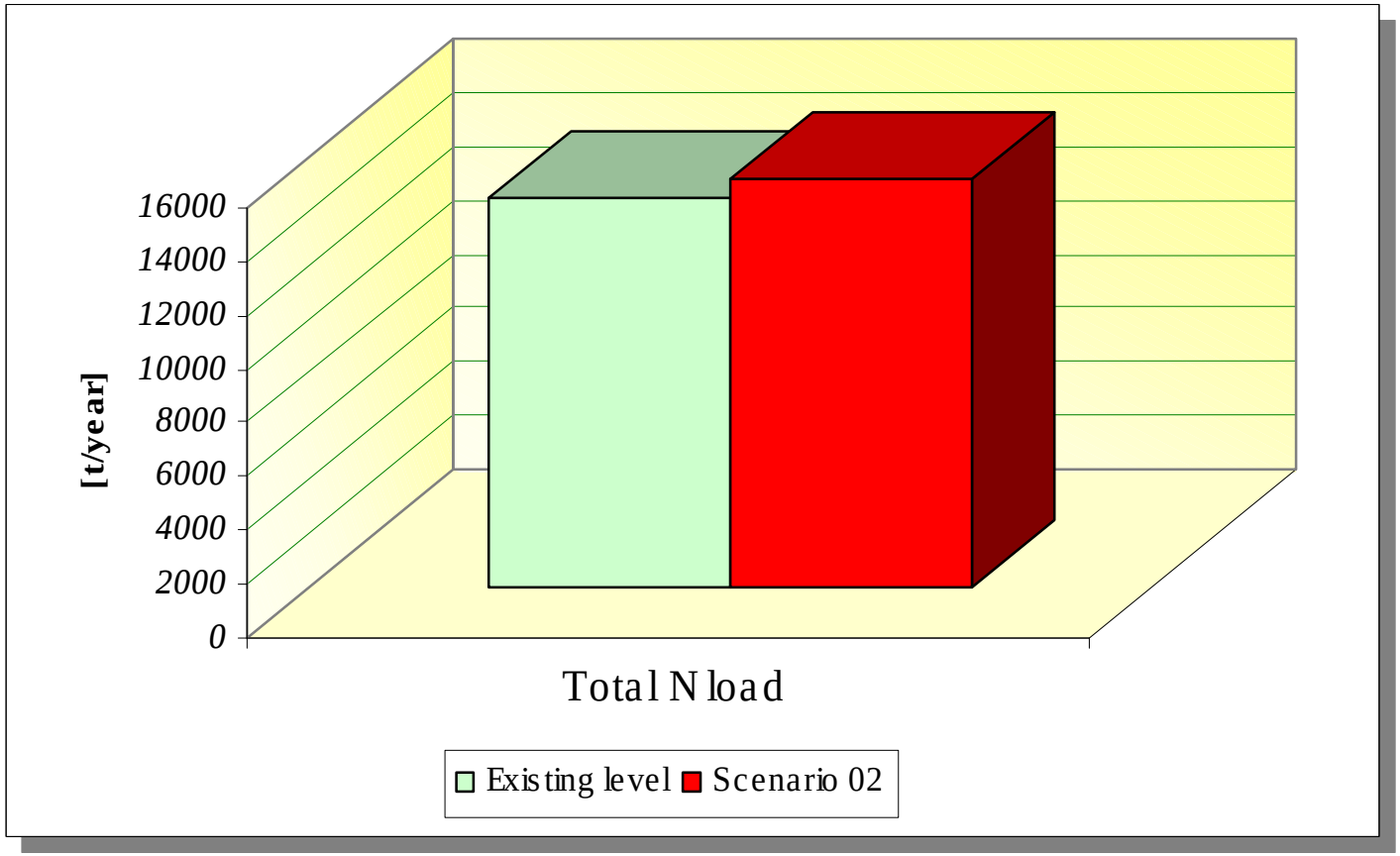
| [t/year] | Direct point sources | | 'Indirect' point source load | Diffuse load |
|---|---|---|---|---|
| | collector | Polish WWTP | | |
| **Existing situation** | | | | |
| **N load** | 2031.60 | 800 | 4080.93 | 7578.88 |
| **P load** | 135.24 | 160 | 404.80 | 217.97 |
| **Levels of reduction/increasing** | | | | |
| **N load** | - 70% | - 80% | - 80% | + 80% of agricultural load |
| **P load** | - 60% | - 80% | - 80% | + 80% of agricultural load |
| **SCENARIO 02 RESULTS** | | | | |
| **N load** | 609.48 | 160 | 816.19 | 13 669.26 |
| **P load** | 54.10 | 32 | 80.96 | 392.35 |

**SCENARIO 02** TOTAL **N load** = **15 264.93** [t/year] Existing level = ***14 491.41***

**SCENARIO 02** TOTAL **P load** = **559.41** [t/year] Existing level = ***918.01***

# S C E N A R I O 02

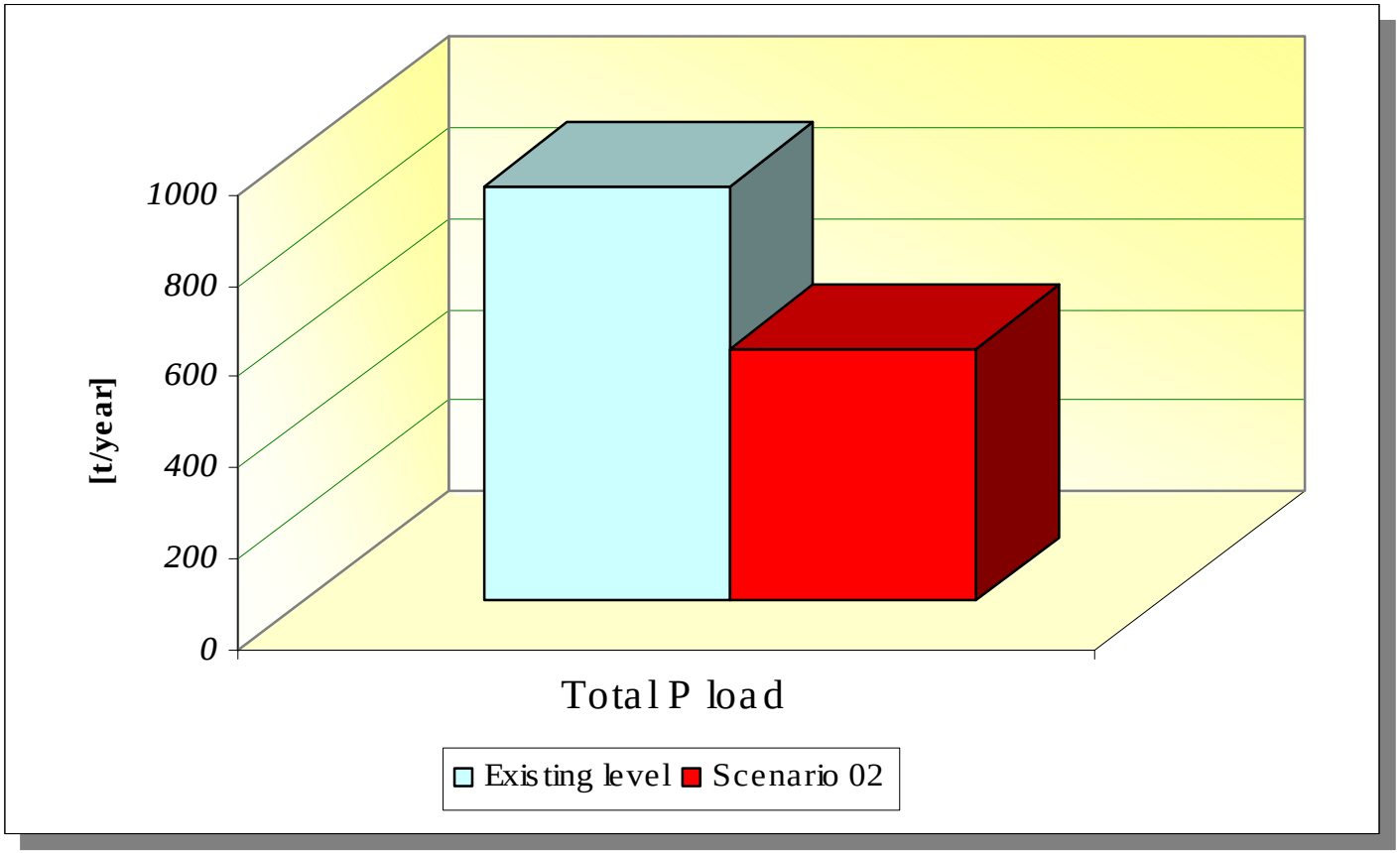
## TARGET DEVELOPMENT




COMPARISON OF TOTAL **NITROGEN** CONCENTRATIONS [mg/l]
BETWEEN SCENARIO 02 (RED) AND SCENARIO 01 (GREEN)

# S C E N A R I O 02

## TARGET DEVELOPMENT




COMPARISON OF TOTAL **PHOSPHORUS** CONCENTRATIONS [mg/l]
BETWEEN SCENARIO 02 (RED) AND SCENARIO 01 (BLUE)

# S C E N A R I O 03

## TARGET DEVELOPMENT

**OPTIMAL SCENARIO – IS BASED ON THE ASSUMPTION THAT POLISH AND RUSSIAN FARMERS WILL APPLY ALL REQUIRED RULES AND LAWS INTO PRACTICE. AGRICULTURAL PRACTICES IN THE 03 SCENARIO FOLLOW POLISH CODE OF GOOD AGRICULTURAL PRACTICE AND POLISH LAWS IMPLEMENTING NITRATE DIRECTIVE IN POLAND. THE SAME CONCERNS RUSSIAN FARMERS.**

Decrease of point sources load (new and modernized water treatment plants)

*Decrease of non-point sources load:*

- Change of agricultural practice: proper manure storage, proper tanks for liquids, straw incorporation not burning, spring application of manure and its incorporation within 6 hours

- Increase animal production to optimal level (0.8 AU per ha)

- Existing crop yield (20 dt/ha)

- Optimal use of fertilizers: increase use of organic fertilizers and decrease use of mineral fertilizers: 85 kg of organic N + 65 kg of mineral N

# S C E N A R I O 03

## TARGET DEVELOPMENT

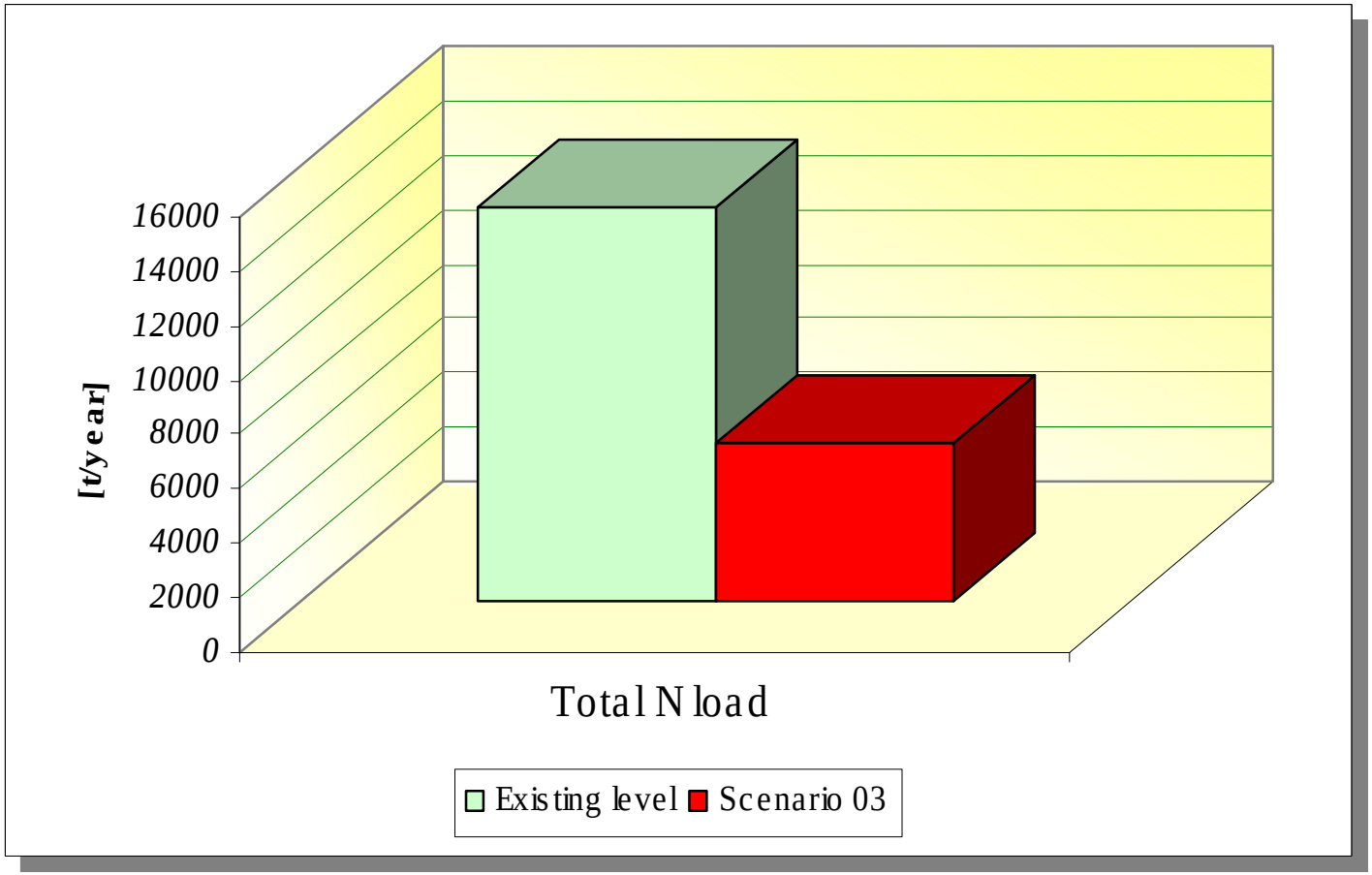
| [t/year] | Direct point sources | | 'Indirect' point source load | Diffuse load |
|---|---|---|---|---|
| | collector | Polish WWTP | | |
| **Existing situation** | | | | |
| **N load** | 2031.60 | 800 | 4080.93 | 7578.88 |
| **P load** | 135.24 | 160 | 404.80 | 217.97 |
| **Levels of reduction/increasing** | | | | |
| **N load** | - 70% | - 80% | - 80% | - 45% of agricultural load |
| **P load** | - 60% | - 80% | - 80% | - 45% of agricultural load |
| **SCENARIO 03 RESULTS** | | | | |
| **N load** | 609.48 | 160 | 816.19 | 4 176.72 |
| **P load** | 54.10 | 32 | 80.96 | 119.88 |

**SCENARIO 03** TOTAL **N load** = **5 762.41** [t/year] Existing level = ***14 491.41***

**SCENARIO 03** TOTAL **P load** = **286.94** [t/year] Existing level = ***918.01***

# S C E N A R I O 03

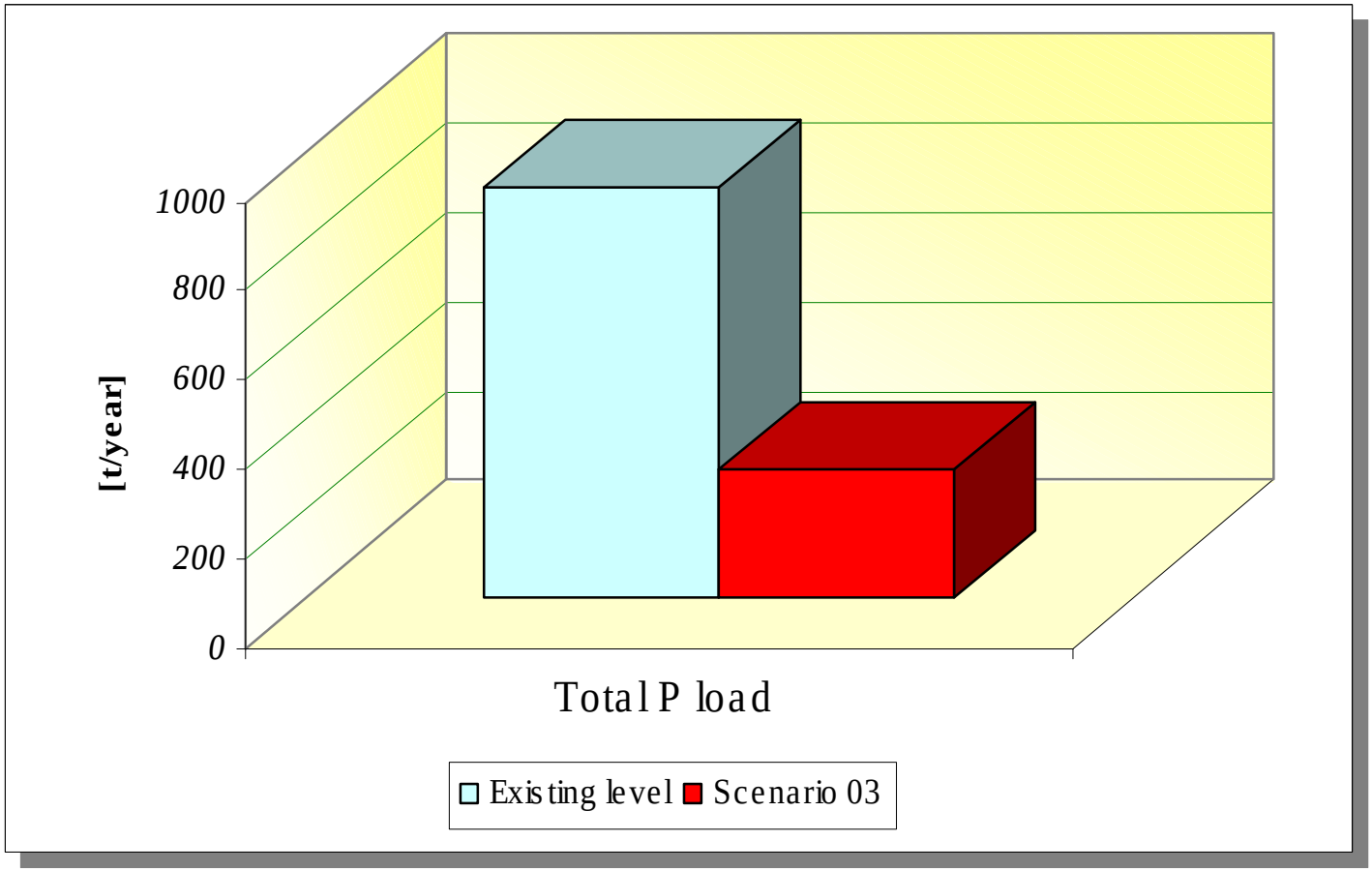
## TARGET DEVELOPMENT




COMPARISON OF TOTAL **NITROGEN** CONCENTRATIONS [mg/l]
BETWEEN SCENARIO 03 (RED) AND SCENARIO 01 (GREEN)

# S C E N A R I O 03

## TARGET DEVELOPMENT




COMPARISON OF TOTAL **PHOSPHORUS** CONCENTRATIONS [mg/l]
BETWEEN SCENARIO 03 (RED) AND SCENARIO 01 (BLUE)

# S C E N A R I O 04

## ISOLATIONIST

**THIS SCENARIO ANALYSES POTENTIAL SITUATION OF NON-EQUAL DEVELOPMENT OF TWO PARTS OF THE LAGOON CATCHMENT: RUSSIAN AND POLISH. IT MAY BE ASSUMED THAT DUE TO POLITICAL AND ECONOMICAL CHANGES POLISH PART OF THE CATCHMENT WILL DEVELOP SIGNIFICANTLY WHILE RUSSIAN PART WILL STAY ON THE LEVEL AS IT IS TODAY. IT IS THE AIM OF THIS SCENARIO ANALYSIS TO INVESTIGATE THE EFFECT OF SUCH A 'ISOLATIONISTS' DEVELOPMENT ON THE VISTULA LAGOON NUTRIENT LOADING.**

Decrease of point sources load (new and modernized water treatment plants)

*Non-point sources loads:*

POLISH PART: Decrease of non-point sources load as in SCENARIO 03, i.e.:

- Change of agricultural practice :proper manure storage, proper tanks for liquids, straw incorporation not burning, spring application of manure and its incorporation within 6 hours

- Increase animal production to optimal level (0.8 AU per ha)

- Existing crop yield (20 dt/ha)

- Optimal use of fertilizers: increase use of organic fertilizers and decrease use of mineral fertilizers: 85 kg of organic N + 65 kg of mineral N

RUSSIAN PART: no development and no changes – loads at the level as in SCENARIO 01

# S C E N A R I O 04

## ISOLATIONIST

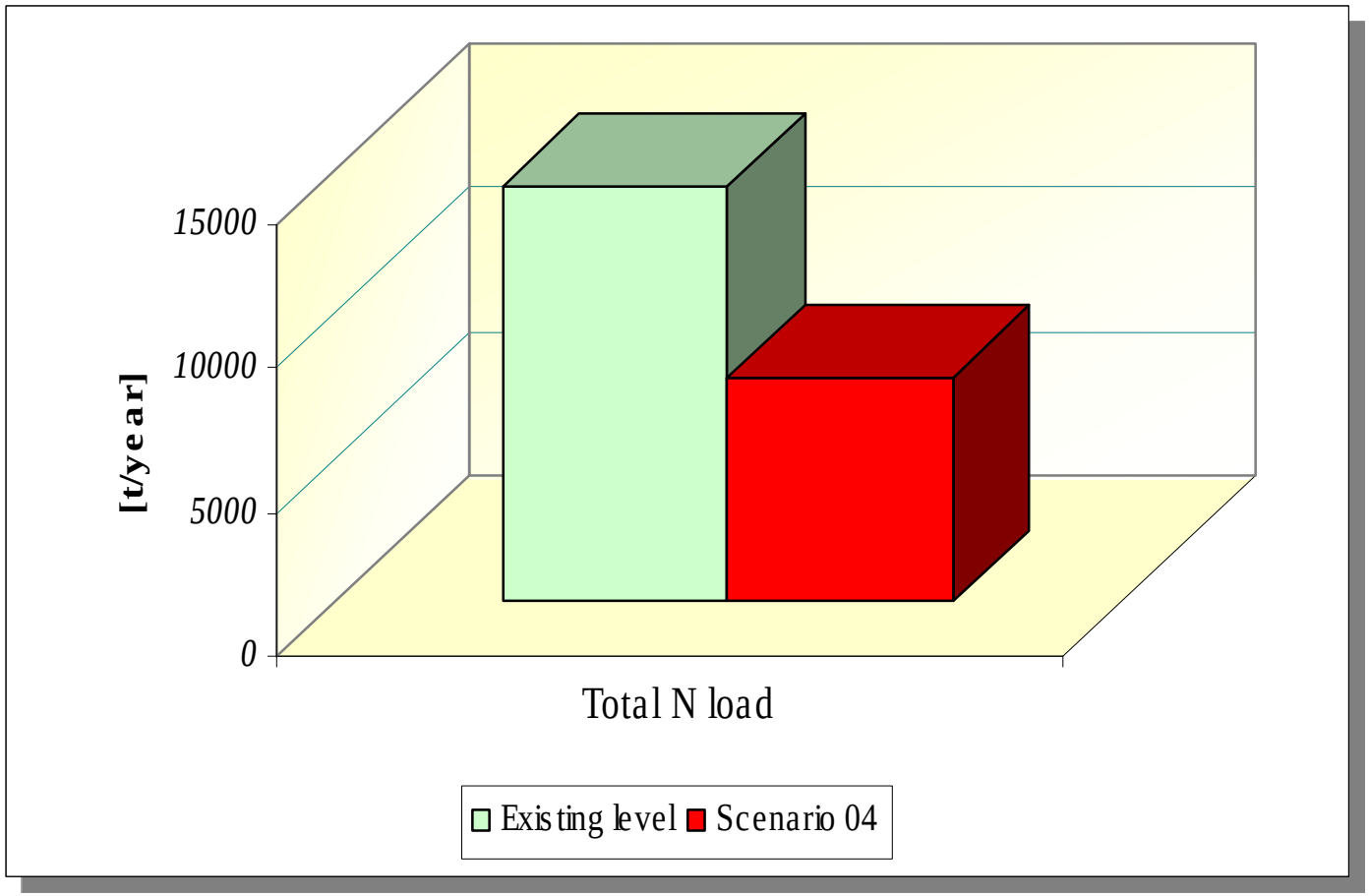
| [t/year] | Direct point sources | | 'Indirect' point source load | Diffuse load |
|---|---|---|---|---|
| | collector | Polish WWTP | | |
| **Existing situation** | | | | |
| **N load** | 2031.60 | 800 | 4080.93 | 7578.88 |
| **P load** | 135.24 | 160 | 404.80 | 217.97 |
| **Levels of reduction/increasing** | | | | |
| **N load** | - 70% | - 80% | - 80% | **-45%** of Polish agricultural load<br>No changes in Russian part |
| **P load** | - 60% | - 80% | - 80% | **-45%** of Polish agricultural load<br>No changes in Russian part |
| **SCENARIO 04 RESULTS** | | | | |
| **N load** | 609.48 | 160 | 816.19 | 6185.22 |
| **P load** | 54.10 | 32 | 80.96 | 146.99 |

**SCENARIO 04** TOTAL **N load** = **7770.89** [t/year] Existing level = ***14 491.41***

**SCENARIO 04** TOTAL **P load** = **317.05** [t/year] Existing level = ***918.01***

# S C E N A R I O 04

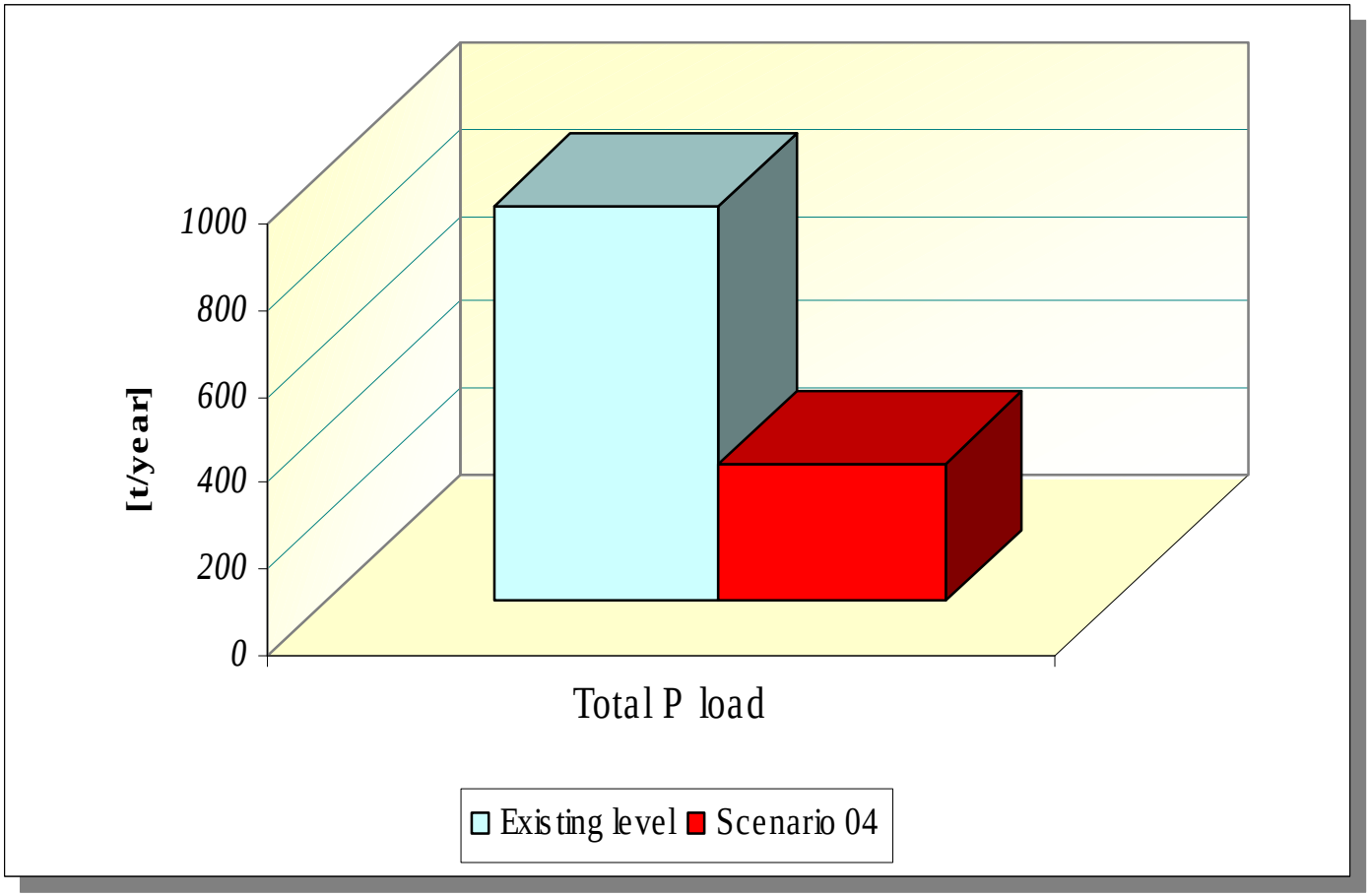
## ISOLATIONIST




COMPARISON OF TOTAL **NITROGEN** CONCENTRATIONS [mg/l]
BETWEEN SCENARIO 04 (RED) AND SCENARIO 01 (GREEN)

# S C E N A R I O 04

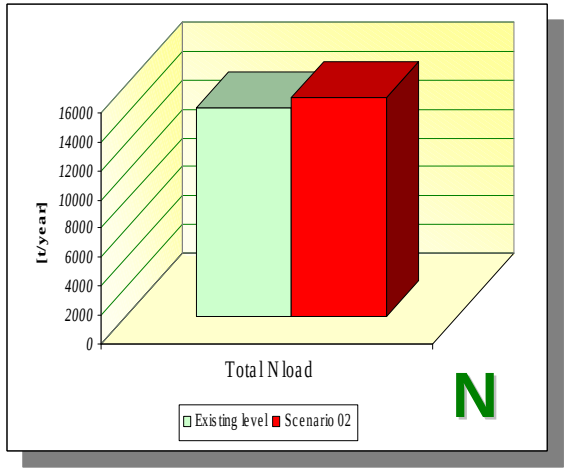
## ISOLATIONIST

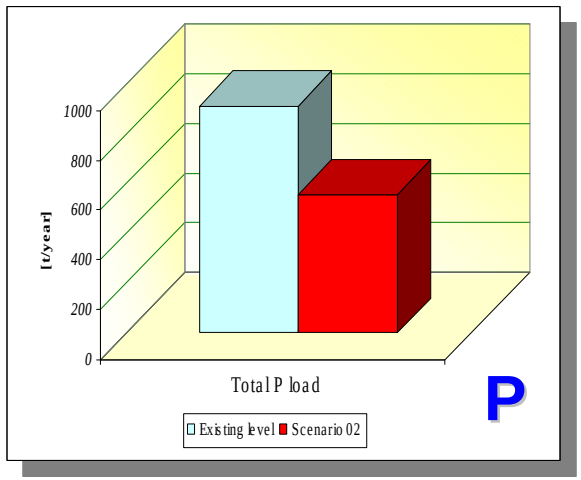



COMPARISON OF TOTAL **PHOSPHORUS** CONCENTRATIONS [mg/l]
BETWEEN SCENARIO 04 (RED) AND SCENARIO 01 (BLUE)

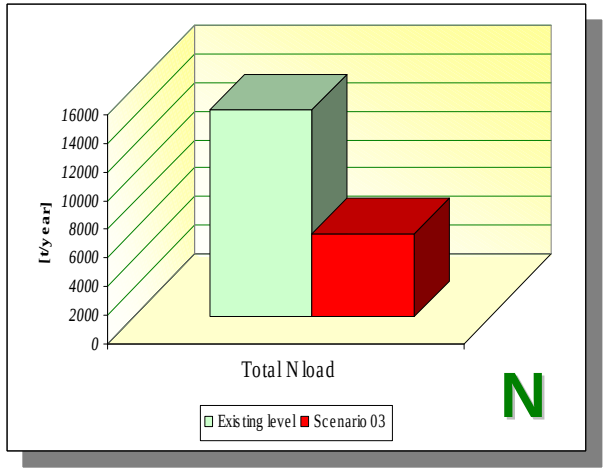
# S C E N A R I O S

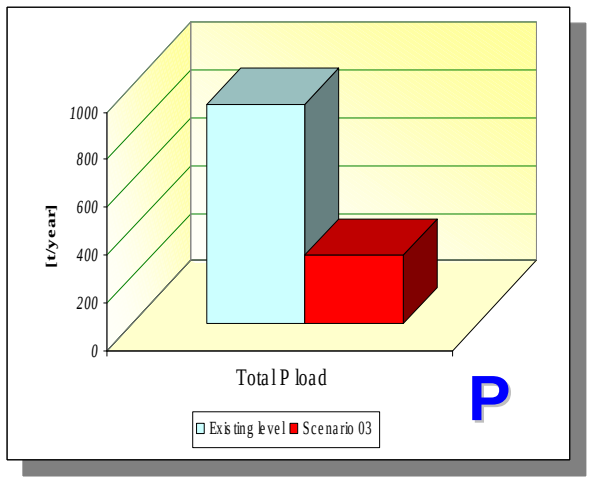
## SCENARIO 02



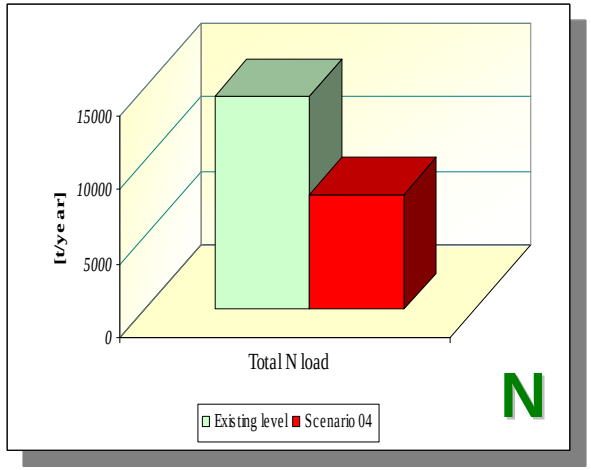



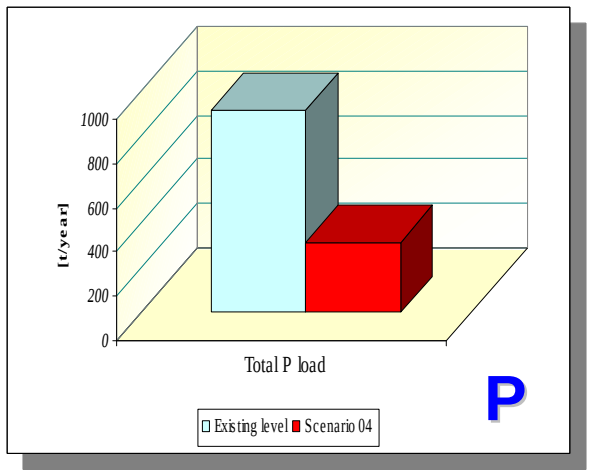

## SCENARIO 03




## SCENARIO 04



# CONCLUSIONS

AS IT HAS BEEN PROVED BY RESULTS OF SCENARIOS CALCULATIONS IN ORDER TO MITIGATE THE NEGATIVE EFFECT OF POTENTIAL ANIMAL AND YIELD PRODUCTION INCREASE SOME ACTIONS AND CHANGES IN EXISTING AGRICULTURAL PRACTICES SHOULD TAKE PLACE:

- **Straw should be incorporated in the soil – not burned how it is now a very common practice**
- **Crop rotation should change a little from cereals after cereals rotation**
- **Manure should be stored on appropriately prepared places – not on bared soil**
- **Urine and slurry tanks should be thigh and has sufficient storage capacity (at least 6 months according to Nutrient Directive)**