5.1 Exercise: NPK input price change with the policy editor

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Background: with and without market model

- Input price changes can be applied in CAPRI for both task:
  - Run scenario with market model
  - Run scenario without market model
- Input prices for mineral fertilizer are exogenous to the model

Economic Background

$$profit = P_W Q(N) - P_N N(Q)$$

$P_W = Price\ of\ wheat$

$P_N = Fertilzer\ Price\ of\ nitrate$

$Q = Production\ of\ wheat$

$N = Fertilzer\ Input$

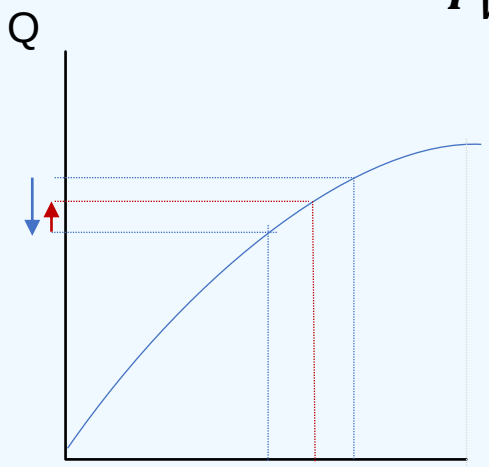
$$max(profit) = \frac{profit}{\partial N}$$

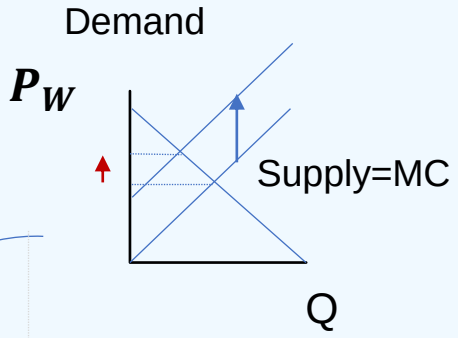
$$P_w \frac{\partial Q}{\partial N} - P_N = 0$$

$$P_w \frac{\partial Q}{\partial N} = P_N$$

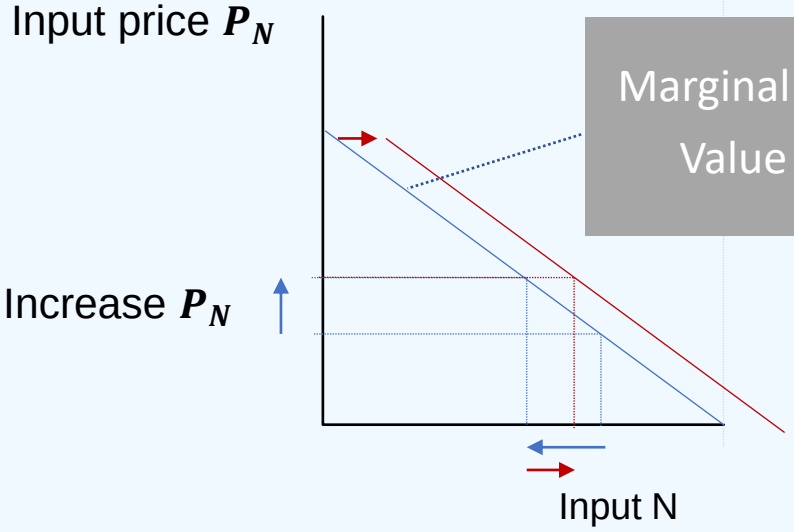
$$P_w = \frac{\partial N}{\partial Q} P_N$$

Production function





Marginal value product (MVP)



Marginal Production Value = $\frac{dQ}{dN} P_w$

Important code parts

```
$setglobal SCENDES Fertilzer Prices increasing due to CO2 tax
*
*  Baseline scenario
*
$include ..\gams\scen\base_scenarios\CAP_2014_2020.gms
*
*  Category : Price shocks
*
  DATA(RMSSUP,"UVAG","NITF","ChangeFactor") = 1.80;
  DATA(RMSSUP,"UVAG","POTF","ChangeFactor") = 1.80;
  DATA(RMSSUP,"UVAG","PHOF","ChangeFactor") = 1.80;
```

```
"..\gams\capmod\inflation_and_trend_interpolation.gms"
*
*      ----- take over price changes from scenario definition
*
DATA(MS,"UVAG",IO,"Y")  $ DATA(MS,"UVAG",IO,"AbsoluteLevel")    = DATA(MS,"UVAG",IO,"AbsoluteLevel");
DATA(MS,"UVAG",IO,"Y")  $ DATA(MS,"UVAG",IO,"AbsoluteChange")   = DATA(MS,"UVAG",IO,"Y") +
DATA(MS,"UVAG",IO,"AbsoluteChange");


DATA(MS,"UVAG",IO,"Y")  $ DATA(MS,"UVAG",IO,"ChangeFactor")     = DATA(MS,"UVAG",IO,"Y") *
DATA(MS,"UVAG",IO,"ChangeFactor");


DATA(MS,"UVAG",IO,"Y")  $ DATA(MS,"UVAG",IO,"PercentageChange") = DATA(MS,"UVAG",IO,"Y") * (1. +
DATA(MS,"UVAG",IO,"PercentageChange")/100);
```

The objective function

```
"..\gams\supply\Supply_model.gms"
*---------------------------------------------------------------------------

OBJEQF_..  v_obje =E= SUM(RUNR,
*           --- revenues - variable costs
            v_linObjePart(RUNR) - v_sumOfPmpTermsLevls(RUNR
*           --- contribution of PMP terms for feeding
           + v_sumOfPmpTermsFeed(RUNR)
           - v_pmpCostLandMarket(RUNR

           - v_landSupCost(RUNR)
           );

*---------------------------------------------------------------------------

*            + sales valued with expected prices
*            - purchases of inputs valued with expected prices
*            - sum cost of variable inputs excluding feed, young animals
*            + sum of premiums
LINEAR_(RUNR)..    v_linObjePart(RUNR)  =E=
*       --- sales/purchases valued by "unit value" price
*           from gross Economic Accounts for Agriculture
*
  SUM(RUNR_OMOBJE(RUNR,OM_OBJE),
       v_netPutQuant(RUNR,OM_OBJE) * ( SUM(R_RAGG(RUNR,MSACT),

      (%data%(MSACT,"UVAG",OM_OBJE,"Y"))

…

*      --- activity levels multiplied with
*          variable costs (excluding feed and animals), negative values
*          premimums for specific alternatives
*          premimums defined in policy data set
+ SUM((MPACT,A)  $ p_techFact(RUNR,MPACT,"LEVL",A),
             v_actLevl(RUNR,MPACT,A)  * (p_linObjeCont(RUNR,MPACT,A)
     +%data%(RUNR,MPACT,"PRME","Y")*(1+p_techFact(RUNR,MPACT,"PRME",A))))
…
;
```

Important code parts

```
"..\gams\sets.gms"


SET FNUT_ROWS "Mineral fertilizing inputs" /
  NITF   "Nitrogen in fertiliser"
  PHOF   "Phospate in fertiliser [P2O5]"
  POTF   "Potassium in fertiliser [K2O]"
  /;

SET OM_OBJE(ROWS) "Goods in objective of supply model" /
 SWHE , DWHE , RYEM , BARL , OATS , MAIZ , OCER , PARI,
 RAPE , SUNF , SOYA , OLIV,
 PULS , POTA,  SUGB , TEXT, TOBA,
 TOMA , OVEG,  APPL , OFRU, CITR, TAGR,  TABO,  TWIN
 COMI ,
 BEEF , PORK , SGMI , SGMT , EGGS , POUM ,

 SET.OYANI_ROWS,
 SET.FNUT_ROWS

 **** use of bulk feedingstuff

 FCER ,FPRO ,FENE ,FMIL ,FOTH /;
```

Expectations

- Yield
- Supply
- Price
- Mineral fertilizer use
- Income

Breakout session

- We split randomly the group in groups of 3 participants
- You have 30 min
  - run the scenario
  - fill out the quiz provided in the ppt
  - provide 1-2 slide additional results in the area of
    - Income, production, environmental indicators, trade
- Please indicate one member of the group to present the group work at the end in about 2-5 min

Exercise 5.1.1 input price shock for fertilizer

- Introduce a price change of +80% for mineral fertilizer
- Find, modify and save the code snippet from the policy editor for “higher fertilizer prices”
- Store the scenario from the wiki (or next slide) into the userScenc folder and run the model
- Proof that the price shock was correctly translated into the model for the run without market model for Germany
- Fill the cloze at the end of the presentation using the results for with market model from the zip file, where we assumed that fertilizer prices increase in all countries of the EU

Scenario in GAMS

```
$setglobal SCENDES Fertilzer Prices increaseing due to CO2 tax

$include ..\gams\scen\base_scenarios\CAP_2014_2020.gms

  DATA(RMSSUP,"UVAG","NITF","ChangeFactor") = 1.80;
  DATA(RMSSUP,"UVAG","POTF","ChangeFactor") = 1.80;
  DATA(RMSSUP,"UVAG","PHOF","ChangeFactor") = 1.80;
```

Relevant tables in the exploiter

- For supply, hectare and heard size, income and yield by activity see farm->Supply Details
- For total price changes see -> table Prices
- For Nitrate change see -> table environment->Nutrient balances -> Gross nutrient budgets

Cloze for Exercise 5.1.1 for Germany

- Check that fertilizer prices are increased by 80% in both runs, with and without the market model.

Without and with the market model in bracket:

- The change in supply for soft wheat is __%(__ %) and for hectare __%/__%). The price change for soft wheat is __%(__%).
- In sum, the change in mineral fertilizer for nitrate in Germany is __%(__%). Is manure production increasing/decreasing?
- Production (supply) of pulses in/decrease by __%(__%), cattle herd sizes in/decrease?
- Farm income decreased by __%(__%). Why?

Cloze for Exercise 5.1.1 for Germany

- Check that fertilizer prices are increased in both runs, with and without the market model, are 80%.

Without and with the market model in bracket:

- The change in supply for soft wheat is -23.29%(0.85%) and for hectare –19.64%(-0.86%). The price change for soft wheat is 0%(+12.25%).
- In sum, the change in mineral fertilizer for nitrate in Germany is -19.9%(-4.29%). Is manure production increasing/~~decreasing~~?
- Production (supply) of pulses in/~~de~~crease by 36.81%(decreases by 24.33%), cattle herd sizes in/~~decrease~~?
- Farm income decrease by 11%(12%)

CAPRI TRUNK

View Handling Windows Options

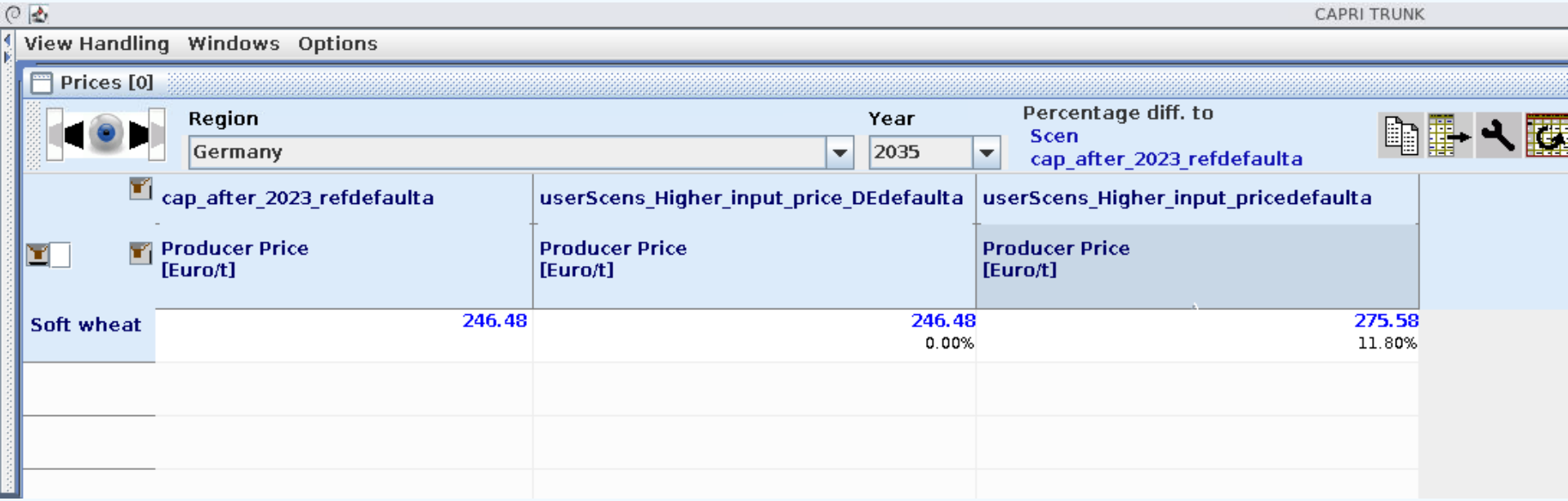
Prices [0]

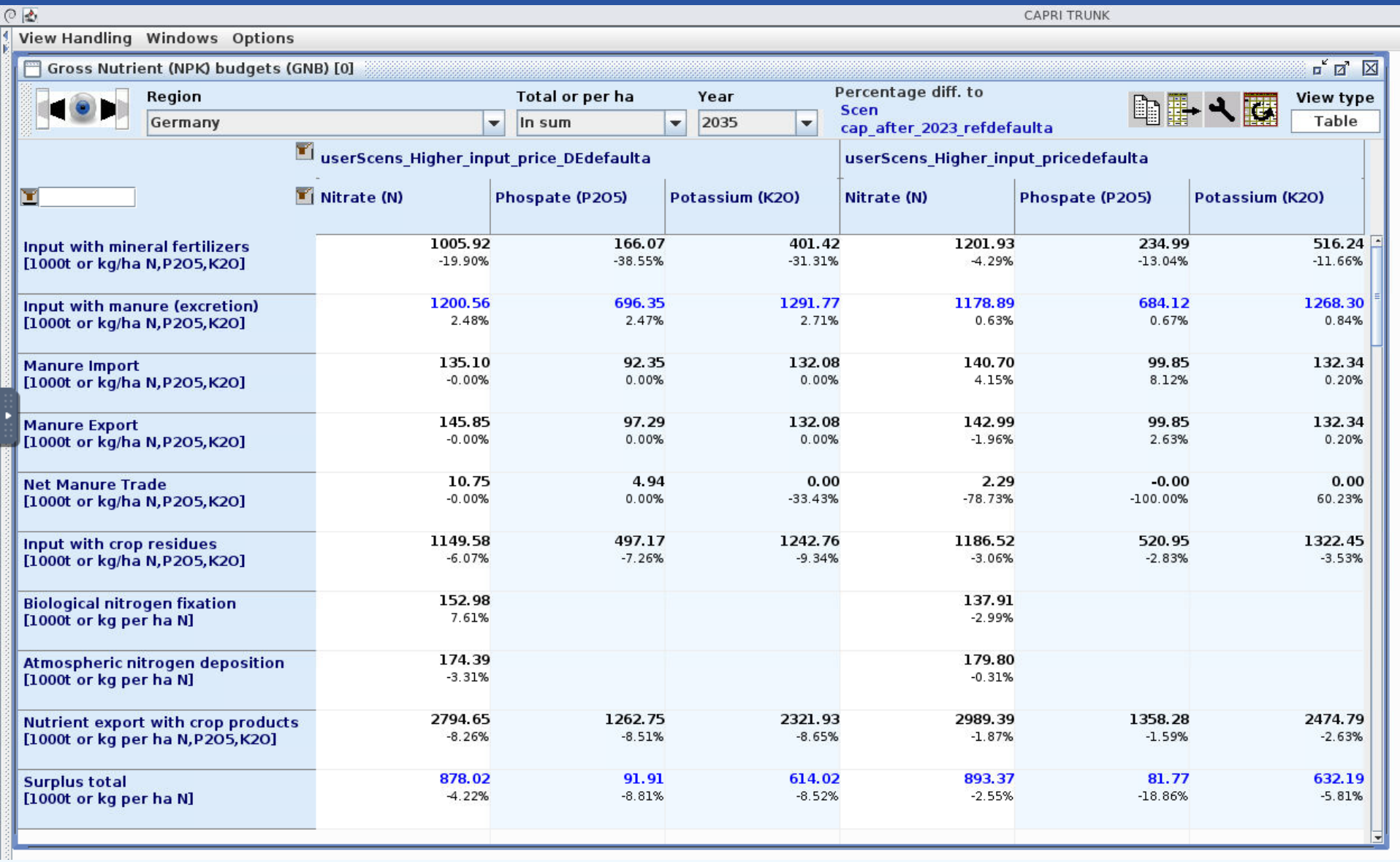
Region: Germany

Year: 2035

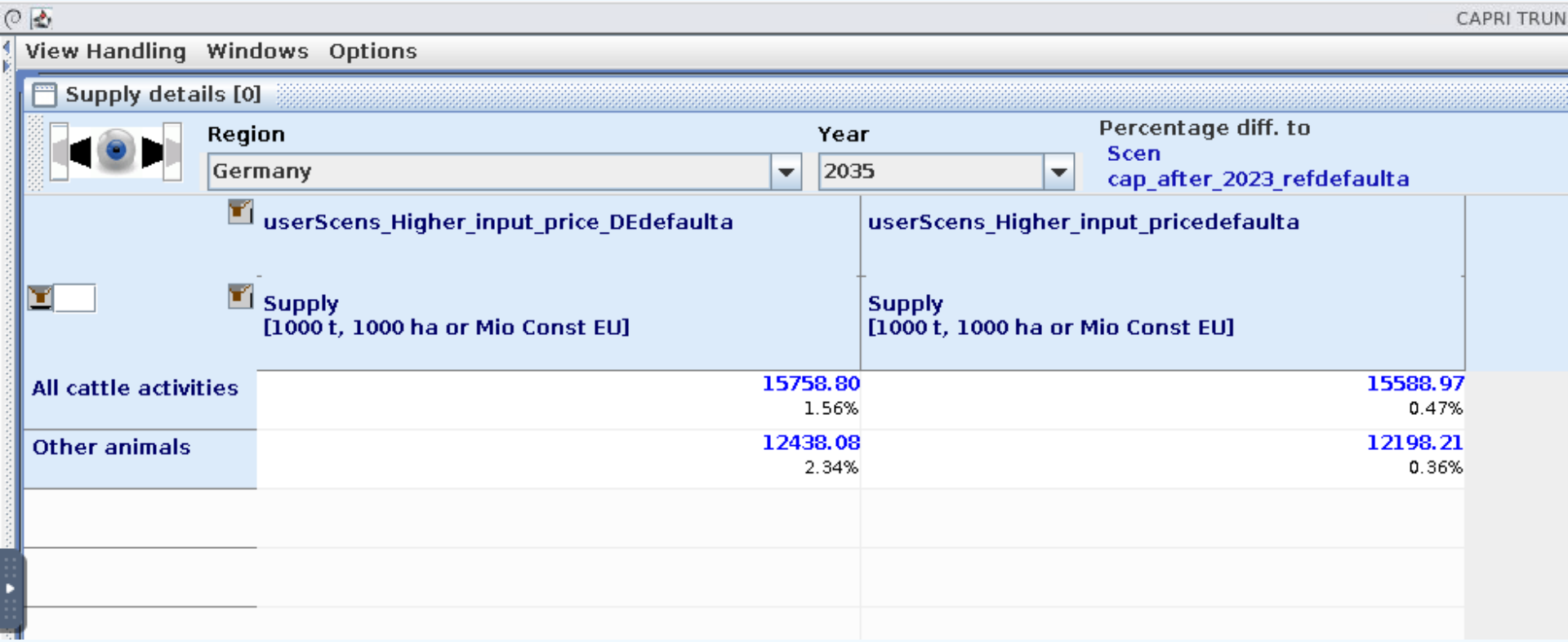
Percentage diff. to Scen cap_after_2023_refdefaulta

	cap_after_2023_refdefaulta Producer Price [Euro/t]	userScens_Higher_input_price_DEdefaulta Producer Price [Euro/t]	userScens_Higher_input_pricedefaulta Producer Price [Euro/t]
Fertiliser	1131.42	2037.19 80.06%	2039.44 80.26%
Nitrate (N)	1216.12	2189.02 80.00%	2189.02 80.00%
Phospate (P2O5)	1704.98	3068.96 80.00%	3068.96 80.00%
Potassium (K2O)	730.44	1314.79 80.00%	1314.79 80.00%


CAPRI TRUNK
View Handling
Windows
Options
Prices [0]
Region
Germany
Year
2035
Percentage diff. to
Scen
cap_after_2023_refdefaulta
cap_after_2023_refdefaulta
userScens_Higher_input_price_DEdefaulta
userScens_Higher_input_pricedefaulta
Producer Price [Euro/t]
Producer Price [Euro/t]
Producer Price [Euro/t]
Soft wheat
246.48
246.48
0.00%
275.58
11.80%



	userScens_Higher_input_price_DEdefaulta			userScens_Higher_input_pricedefaulta		
	Nitrate (N)	Phospate (P2O5)	Potassium (K2O)	Nitrate (N)	Phospate (P2O5)	Potassium (K2O)
Input with mineral fertilizers [1000t or kg/ha N,P2O5,K2O]	1005.92 -19.90%	166.07 -38.55%	401.42 -31.31%	1201.93 -4.29%	234.99 -13.04%	516.24 -11.66%
Input with manure (excretion) [1000t or kg/ha N,P2O5,K2O]	1200.56 2.48%	696.35 2.47%	1291.77 2.71%	1178.89 0.63%	684.12 0.67%	1268.30 0.84%
Manure Import [1000t or kg/ha N,P2O5,K2O]	135.10 -0.00%	92.35 0.00%	132.08 0.00%	140.70 4.15%	99.85 8.12%	132.34 0.20%
Manure Export [1000t or kg/ha N,P2O5,K2O]	145.85 -0.00%	97.29 0.00%	132.08 0.00%	142.99 -1.96%	99.85 2.63%	132.34 0.20%
Net Manure Trade [1000t or kg/ha N,P2O5,K2O]	10.75 -0.00%	4.94 0.00%	0.00 -33.43%	2.29 -78.73%	-0.00 -100.00%	0.00 60.23%
Input with crop residues [1000t or kg/ha N,P2O5,K2O]	1149.58 -6.07%	497.17 -7.26%	1242.76 -9.34%	1186.52 -3.06%	520.95 -2.83%	1322.45 -3.53%
Biological nitrogen fixation [1000t or kg per ha N]	152.98 7.61%			137.91 -2.99%		
Atmospheric nitrogen deposition [1000t or kg per ha N]	174.39 -3.31%			179.80 -0.31%		
Nutrient export with crop products [1000t or kg per ha N,P2O5,K2O]	2794.65 -8.26%	1262.75 -8.51%	2321.93 -8.65%	2989.39 -1.87%	1358.28 -1.59%	2474.79 -2.63%
Surplus total [1000t or kg per ha N]	878.02 -4.22%	91.91 -8.81%	614.02 -8.52%	893.37 -2.55%	81.77 -18.86%	632.19 -5.81%


CAPRI TRUN
View Handling Windows Options
Supply details [0]
Region
Germany
Year
2035
Percentage diff. to
Scen
cap_after_2023_refdefaulta
userScens_Higher_input_price_DEdefaulta
Supply
[1000 t, 1000 ha or Mio Const EU]
userScens_Higher_input_pricedefaulta
Supply
[1000 t, 1000 ha or Mio Const EU]
All cattle activities
15758.80
1.56%
15588.97
0.47%
Other animals
12438.08
2.34%
12198.21
0.36%

CAPRI TRUNK

View Handling Windows Options

Welfare overview [0]

Region: Germany | Year: 2035 | Percentage diff. to Scen: cap_after_2023_refdefaulta | View type: Table

	cap_after_2023_refdefaulta	userScens_Higher_input_price_DEdefaulta	userScens_Higher_input_pricedefaulta
Agricultural income EAA (supply models) [Mio Euro]	48008.97	41751.77 -13.03%	43838.36 -8.69%
Agricultural income computed from activities (MGVA*LEVL) [Mio Euro]	49287.92	43030.71 -12.70%	45117.30 -8.46%
Agric profit after emission tax payments (subsidy receipts if negative) [Mio Euro]	40679.11		36940.64 -9.19%
Premiums [Mio Euro]	5339.02	5242.64 -1.81%	5332.66 -0.12%
EAA Output [Mio Euro]	90920.35	89967.32 -1.05%	93858.13 3.23%
Output crops [Mio Euro]	39687.30	37955.42 -4.36%	42611.30 7.37%
Output animals [Mio Euro]	51233.05	52011.89 1.52%	51246.83 0.03%
EAA Input [Mio Euro]	48250.41	53458.19 10.79%	55352.44 14.72%
Crop specific Input [Mio Euro]	9538.19	14193.91 48.81%	15161.56 58.96%
Animal specific Input [Mio Euro]	20979.26	22144.12 5.55%	22549.67 7.49%
Other Input [Mio Euro]	17732.96	17120.16 -3.46%	17641.21 -0.52%