



# **Nutrient Leaching Coefficient Calculating System 2.1 (NLeCCS)**

## **Technical description**

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## Introduction

NLeCCS (Nutrient Leaching Coefficients Calculation System) is a system for calculating climate normalized nitrogen and phosphorus leaching coefficients for agricultural land. NLeCCS consists of several computer programs and a standard method to carry out the calculations. A schematic representation of the system is shown in Figure 1.

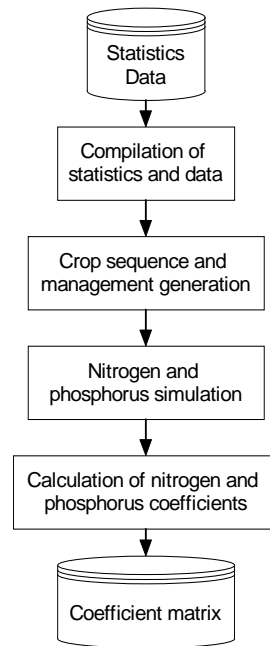


Figure 1. Simplified picture of the NLeCCS system.

### **Programs in NLeCCS**

A detailed description of all databases, programs and flows of data is shown in Figure 2. The programs included in NLeCCS are:

- the Climate Database Constructor 2.1.2 (CDC)
- the Crop Sequence and Management Generator 4.0.34 (CSMG)
- the Average Discharge Calculator 1.0 (ADC)
- the SOILNDB 3.0.36 model that incorporates the SOIL and SOILN models
- the Crop average MS Excel Macro
- the ICECREAMDB 1.0.34 a front-end for the ICECREAM model
- the Completer 1.0.6
- the Crop Sequence Manipulator 0.0.4 (CSM)

## Dataflow and short description of programs

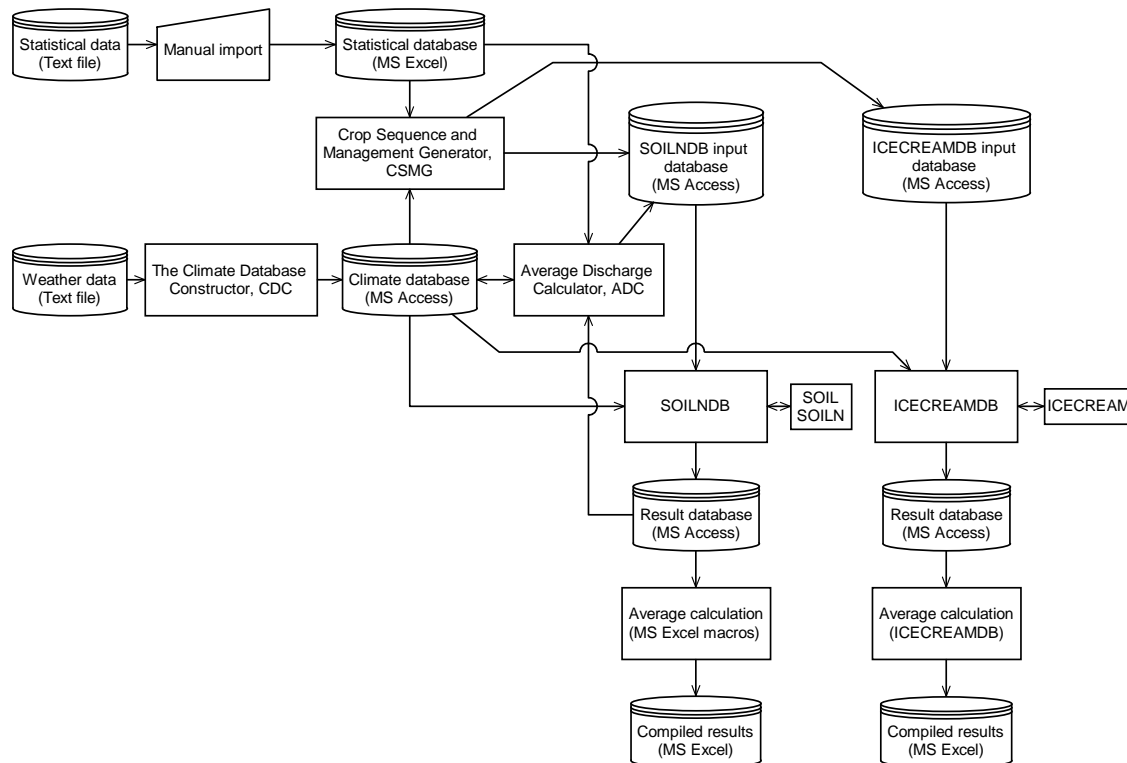


Figure 2. A detailed description of the NLeCCS system.

### Statistical data

The *statistical data* that are to be used as input for the simulations are manually imported into the *Statistical database* a MS Excel workbook. Some additional data are also entered into the database.

### Climate data

The *weather data* is received in text file format, these are imported into the *Climate database*, a MS Access database with the *Climate database constructor* (CDC). The CDC also calculates the length of the growing season from the period's daily average temperatures. The growing season is defined as the period when the temperature is persistently above +4°C.

### Management data

The *Crop Sequence and Management Generator* (CSMG) is a program that utilizes agricultural statistics as an input and generates databases with time series of crops and managements. These databases are used as input for the calculation of the normalized leaching coefficients with *SOILNDB* (nitrogen) and with *ICECREAMDB* (phosphorus). The method for calculating nutrient leaching coefficients with NLeCCS is based on very long (typically 10 000 years) management time series that are simulated in short parts (20-30 years) with the same climate data. The number of times each crops appear in the crop sequence is proportional to the area of the crop in the region for which the statistics comes.

Also several rules are applicable to the randomization, where certain crops can not follow other crops. The crop sequence is then used as a base to generate a whole management practice, including fertilization, soil tillage, sowing date, catch crop etc for each region. Databases are generated for all soils present in the region, each soil having the same management. For phosphorus simulations, slope and soil phosphorus level is also part of the output matrix.

This approach produces leaching coefficients that are normalized for variations in climate between different years. The total length of the management time series is set to give coefficients with low standard errors for the crops that do not have more than a few percent occurrence in the crop sequence.

### **Calibration of water discharge**

Before the database can be used to simulate nutrient losses the simulated water discharge has to be calibrated against a target value for discharge given as input for each region. This is done by simulating a subset of each database, usually 400 years. These result databases from SOILNDB are analyzed in the *Average Discharge Calculator* (ADC), and an adjusted value for the precipitation correction factor is calculated and applied to the Climate database. This procedure is repeated until the deviation between simulated mean discharge and target discharge is within predefined bounds. The ADC then calculates the concentration of nitrogen in the precipitation from the load (kg/ha) of wet deposited nitrogen given as input and the corrected precipitation. This is written to the SOILNDB input database. For ICECREAMDB this calibration process has to be performed manually.

### **SOILNDB, SOIL and SOILN**

*SOIL* and *SOILN* are the actual simulation tools, but they are completely wrapped in *SOILNDB*. *SOILNDB*'s main task in NLeCCS is generate data to feed to the *SOIL* and *SOILN* models and collect the results and save them in an MS Access database, the result database. *SOILNDB* 3.0 can run several *SOILNDB* input databases in sequence without the need of user interaction.

### **Compilation of the nitrogen coefficients**

The results of the *SOILNDB* simulations are read into MS Excel workbooks with an Excel macro. The macro calculates crop mean values for several parameters such as discharge, mineralization, N leaching etc. The matrix consists of nitrogen concentrations for different crop and soil combinations.

### **ICECREAMDB and ICECREAM**

*ICECREAMDB* is a graphical front-end to the simulation model *ICECREAM* and its purpose is to facilitate simulations of long time series. Something that is very hard to do with *ICECREAM*. *ICECREAMDB* automatically calculates leaching coefficients for phosphorus. The coefficient matrix consists of phosphorus concentrations for combinations of different crops, soils, slopes, soil phosphorus levels and type of fertilization (manure or mineral fertilization). Phosphorus coefficients are also split into solute phosphorus and particle bound phosphorus via surface runoff and drain discharge.

## **Completion and formatting of the result**

The result from the simulations is not complete as crops with less than 1% of the total area are not simulated. The leaching coefficients for these crops are substituted with averages of some other crops. Further more if the coefficients are used by SMHI (Swedish Meteorological and Hydrological Institute) and/or TBV (Tekniskt Beräkningssystem Vatten) they must be written to files with specified formats. This is the job of the Completer.

## **Crop Sequence Manipulator**

With the Crop Sequence Manipulator, CSM, is it possibly to change certain elements in a crop sequence database. This is done in order to be able to analyze the effect on the leaching coefficients from this property. It is possibly to change or remove the catch crop. The distribution between autumn and spring application of manure and the distribution between manured crops and crops receiving chemical fertilizer is also changeable.

## **Climate Database Constructor 2.1.2**

The CDC is a program that reads a climate database in text format and saves the climate data in a Climate database in MS Access format. It also calculates the start and end dates for the growth season. Some additional user entered data is also saved in the database. The CDC can generate a new climate database or save additional climates to existing databases. The current version of CDC can not write the *Metadata* table which is used by the ICECREAMDB program. The *Metadata* table contains similar information as the *Coupling* table.

### ***Length of growth season***

The *Coupling* table in the climate database contains among other data the length of the growth season. This is defined to start when daily mean temperature is persistently above a threshold value, usually +4 degrees Celsius in the spring and end in the autumn when daily mean temperature is persistently below the threshold. This is calculated in two steps, first the daily average temperature is calculated, that is the average for Jan 1<sup>st</sup>, the average for Jan 2<sup>nd</sup> and so forth. This curve is then smoothed by the application of 20 days floating average. When this mean curve passes the threshold the growth season is stated to start and end. The curve is plotted for visual examination and the start and stop dates can easily be adjusted by the user.

### ***Other parameters***

The user must manually enter the stations name and latitude and the correction factors for precipitation, both rain and snow.

### ***Minimum requirements***

The Climate Database Generator 2.1.2 is written in MS Visual Basic.NET 2003. Minimum requirements are Windows 2000, Windows XP. Microsoft Office 2003 is also needed.

## Average Discharge Calculator 1.0

The average discharge calculator is a program for calibrating the simulated water discharge to the discharge given as input to NLeCCS. It also calculates the concentration of nitrogen in the precipitation, from the nitrogen load and amount of precipitation. This is necessary as the discharge is calibrated with the precipitation correction constant.

In the ADC it is possible to include or exclude the surface runoff from the total discharge that is compared to the target discharge. The total discharge is area dependent. It is calculated from all the simulated soils discharge multiplied with each soils relative area and then summed up.

The program automatically calculates a suggestion of a new value for *preca0*, Eqn 1. But the user can enter any value.

$$\text{New } preca0 = \text{old } preca0 + (\text{target discharge} - \text{discharge}) * 0.002 \quad \text{Eqn. 1.}$$

The wet deposition is a load (kg/ha/year) in the statistical database but a concentration (mg/l) in the SOILNDB input database. The wet deposition is recalculated using a yearly mean value of precipitation calculated from the climate database. The precipitation is corrected using the *preca0* value. If the air temperature is below 0 degrees the *preca1* (snow correction factor) value is added to the *preca0* value.

The ADC also writes a log file that makes it possible to see all the changes made to the databases.

### **Minimum requirements**

The average discharge calculator is written in MS Visual Basic.NET 2003.  
Minimum requirements are Windows 2000, Windows XP.  
Microsoft Office 2003 is also needed.

# Crop Sequence and Management Generator 4.0.34

## ***Introduction***

The workflow in CSMG is the following. First, statistical data is read into the computer memory and a randomized crop sequence is constructed. Then, management is added to the crop sequence and databases are saved for later use by SOILNDB or ICECREAMDB

## ***Randomization of crop sequences***

The total length of the crop sequence is calculated as a multiple of the number of datasets. A normal dataset length is 20 to 30 years, and the normal total length is about 10000 years. Randomization of crops and management is done in several steps. The first step is to construct an array where the crops are assigned a part of the total crop sequence proportional to the crop's area of the total area in the region. Each crop is then divided in fertilized and manured, in accordance with the area of land receiving manure, derived from the statistics for each region. The manured part of the crop is then subdivided into autumn application and spring application of manure. After that, straw removal is distributed for the crop and the fraction of catch crops and spring cultivations is distributed.

Initially, the array consists of blocks of the same crops, sub divided into type of fertilization, straw removal and catch crops and cultivation time. The straw removal, catch crop and cultivation dates are first randomized within each crop block. The crop sequence is then randomized without constraints to minimize residual artifacts in the crop sequence in the cases where the user has selected so many conditions that it is not possible to construct a crop sequence that satisfies all of them at the same time.

The second step is the conditional randomization of the whole crop sequence. During the randomization a number of rules must be obeyed, for example "No ley after potatoes". There are a large number of predefined rules and a possibility for the user to define new rules. The randomization procedure is simply a switch between the crops at two randomly selected positions in the crop sequence. However, in order for the switch to take place, all applied conditions must be satisfied for both the switched crops at their new position. The switching will move the crop together with all other attributes, such as manure type and catch crops. This will result in a crop sequence with the correct representation of the different crops and in most cases with no violations against the randomization rules.

## ***Generation of crop sequences with managements for ICECREAMDB***

For each region three databases can be generated, *i.*) with mineral fertilizer, *ii.*) with manure, and *iii.*) a mixed crop sequence with both fertilization and manure application. This gives an opportunity to have different soil parameters during simulations of systems with animal manure application and system with mineral fertilization. In practice it is the level of phosphorus in the soil that can be of interest to differ between the two systems.

The database is constructed from the randomized crop sequence and data is taken from the statistics database. For each crop there are certain key events that have their dates defined in the statistics database. These are the dates for sowing, harvest and plowing. All other dates are calculated as offsets from these dates. The management is constructed like this:

- **Sowing** Crops are divided in two groups, spring- and autumn-sown crops and for which the dates are given in the statistics database. Leys are an exception and are sown immediately

after the harvest of the preceding crop, because the ICECREAM model does not allow undersown crops. If the first crop in the dataset is a ley it is then spring sown.

- **Harvest** Ley has two harvests while all other crops have one. Dates for harvest and the harvested amounts are given in the statistics database.
- **Plowing** Plowing normally occurs in the autumn, but there is an option to use spring plowing before spring sown crops. If the following crop is a ley or a fallow, no plowing occurs as these are considered to be undersown even if they are sown after the preceding crop. The dates for plowing are set in the different tables in the statistics database. Separate dates can be given for crops where the following crop is autumn sown or spring sown and whether spring plowing is allowed or not. The crop after the last crop in the crop sequence is assumed to be spring sown.
- **Removal of straw after harvest** The occurrence of straw removal is randomized in the crop sequence generation. If straw removal occurs, the date is calculated as harvest date + 1 day. If straw removal would occur on ley it would happen after the second harvest. The percentage of straw that is removed is taken from the statistics database.
- **Catch crops** Catch crops are normally undersown, but this is not feasible in the ICECREAM model, so instead they are sown 2 days after harvest of the preceding crop.
- **Application of fertilizer** The fertilization date for spring sown crops is set to the date for sowing +1 day. For ley, the date is set to the start of the growing season -1 day. Autumn sown crops are fertilized 1 day before the autumn plowing. The amount of fertilizer is taken from the statistics database.
- **Application of manure** In CSMG, manure is complemented by mineral fertilizer. This means that crops that receive manure also get mineral fertilizer. The manure application dates are set as follows:
  - for spring sown crops, 4 days before sowing
  - for autumn sown crops and leys, 2 days before growing season starts
  - in autumn, manure is applied 1 day before the plowing of the preceding crop. If no plowing occurs, application is set to 5 days after harvest of the preceding crop.
  - complementary mineral fertilizer is applied in the spring. If the crop is spring sown, the date is set to the sowing date +1 day. For autumn sown crops and ley, the date is set to the start of the growing season -1 day. The applied amounts of mineral fertilizer and manure are taken from the statistics database.
  - leys can receive an extra summer manure application. This is set to 1 day after the first harvest.

### ***Additional tables in the input database for ICECREAMDB***

Besides the cropping system table that contains the crop sequence and the management of the crops, the database also contains a few other tables:

- **FertType** The FertType table contains the type P application, mineral fertilizer or manure for each crop in the crop sequence. This data is used by ICECREAMDB when calculating the leaching coefficients for manured and fertilized crops if they have been mixed in the same crop sequence.
- **Metadata** The metadata table contains the name of the climate to be used, field width (m), stripnr (ICECREAM has the possibility to divide the field into different strips with different management, this is currently not used in ICECREAMDB), default soil name, default slope class, default soil phosphorus class and the type of P applied (mineral fertilizer, manure or a mix of both). The user selects the climate, soil, slope, soil

phosphorus class and type of P applied in the user interface of CSMG prior to saving the output databases. Field width is taken from the statistics database and stripnr (=1) is given by the program.

- **Reduction** This table contains the “within-field and close-to-field” retention. For phosphorus, two pathways and two constituents are considered; surface runoff and drain discharge along with particle and dissolved phosphorus. The retention, read from the statistics database, can vary between 0 and 1, where zero means no reduction and 1 is total reduction. The reduction parameter should reflect that a portion of the calculated phosphorus losses are, in the case of surface runoff, redistributed within the field or trapped at the field edge and for drain discharge, some water and P by-passes the drain-pipes and is retained in deeper soil. Retention may also occur in field-adjacent open ditches, where sediments (including P) often are removed through ditch cleaning.
- **Yield** The yield table contains the yield (kg/m<sup>2</sup>) for each crop in the crop sequence. The reason it is placed in a table in the cropping database is that it makes it possible to have different yields in different regions of Sweden. If it was placed in the parameter database as the rest of the crop parameters this would not be possible. The yield for each crop is taken from the statistics database.
- **Soils** This table contains the names for the soils that are present in each region. The soils here are used when simulating with the option “all soils in the region” in ICECREAMDB. The list of soils is taken from the statistics database.
- **SoilP** This table contains the content of SoilP (g P/kg soil) for the four soil layers and for three soil phosphorus classes: low, medium and high soil phosphorus level, respectively. The SoilP-data is given in a table in the cropping database to make it possible to have a regional resolution. The data is taken from the statistics database.
- **SlopeClasses** The SlopeClasses table contains segment nr, field length (m) and field slope (m/m) for three slope classes. The ICECREAM model can divide the field into several segments with different slopes. Presently, only one segment is used in ICECREAMDB. The field length and the slopes are taken from the statistics database.
- **Icecream Cropping system** This table contains the version number of the layout of the database and is used to make sure that the database is the one that ICECREAMDB expects.

For in depth information of the tables see “Teknisk Rapport 117. ICECREAMDB 1.0.34, Technical description”.

### ***Generation of crop sequences with managements for SOILNDB 3.x***

The database is constructed from the randomized crop sequence and data is taken from the statistics database. For each crop there are certain key events that have their dates defined in the statistics database. These are the dates for sowing, harvest and plowing. All other dates are calculated as offsets from these dates. The management is constructed like this:

- **ID\_no** Dataset identity number is calculated from a counter.
- **Nr** Row counter, gives the dataset an order.
- **Year** is determined by a year counter and the simulation’s start year.
- **Crop** The crop sequence is determined by the randomization process.
- **PostCrop** The post crop sequence is determined by the randomization process.
- **Harvest** Harvest values are taken from table “Skörd”. In case where the next crop is spring sown, is a ley or a fallow, harvest amount is taken from the column “vårsådd”.

If the next crop is autumn sown, the value is taken from the column “höstsådd”. The last year in the crop sequence is assumed to have a spring sown crop after it.

- **Grain N Content** Value taken from the table “KärnN”. For ley that has lasted for more than 2 years the values is taken from a textbox in CSMG’s user interface “N-Kärna”.
- **Residues N Content** Value taken from table “ResterN”. For ley that has lasted for more than 2 years the values is taken from a textbox in CSMG’s user interface “N-Res”.
- **Removal** the percentage of the simulated harvest that is removed from the field with harvest is taken from the table “Procentuell bortförsel av skörd”.
- **Remove Harvest residues** is a switch determined in the randomization process based on data in the table “Halmskördad areal %”.
- **Sowing date** Different routines for setting the sowing date are used depending on the value in column “Höst/vår” in table “Grödor”. The four acceptable values is “vår”, “höst”, “vall” & “träda” which denotes different crop types. “vår” is a spring sown annual crop. “höst” is a autumn sown annual crop, “vall” is a perennial in sown ley. “träda” is a fallow that is not sown.
  - **“vår”** The sowing date is taken from the table “Såtid”.
  - **“höst”** The sowing date is taken from the table “Såtid”.
  - **“vall”** Both ley and green manure are normally insown in the preceding crop as “Undersown Ley >25%”, that is a clover rich ley. The sow date is the same as for the preceding crop. If it is not possible to insow, ley and green manure are treated differently depending on the cause.

#### **Ley:**

If it is the first year in the whole crop sequence, ley is spring sown at the day specified in the “Coupling” table in the climate database as the date leys start to grow “ley\_upst1”.

If it is not the first year then the sowing data depends on the preceding crop.

If the preceding crop is a ley, the total number of years with ley in a row is compared to the maximum number of years that ley can lay. If it is reached the ley is spring sown at the day specified in the “Coupling” table in the climate database as the date leys start to grow “ley\_upst1”.

If the preceding crop is a green manure no sowing at all is done and the green manure is transformed into a ley and afterwards treated as a ley in all aspects.

If the preceding crop is a fallow the ley is spring sown at the day specified in the “Coupling” table in the climate database as the date leys start to grow “ley\_upst1”.

#### **Green manure:**

If it is the first year in the whole crop sequence, green manure is autumn sown at the date specified in the table “såtid”.

If green manure is preceded by ley or green manure nothing is done and the ley is considered a green manure from this point.

If green manure is preceded by fallow there is a severe problem, the green manure is insown but fallow has no sow date.

- **“träda”** Fallow is not sown.

Post crops are sown at the same date as the crops they are insown in are sown. Post crops can only come after annual crops.

- **Harvest date** for the first harvest is taken from the table “Skördtid” except for fallow that is not harvested. For crops that have several harvests per season the second and third harvest dates is taken from the tables “Skördtid2” and “Skördtid3” respectively.
- **Stubbel date** If the crop has a post crop it is not stubbled. The stubble date depends on the following crop. Different routines for setting the sowing date are used depending on the value in column “Höst/vår” in table “Grödor” for the following crop. The four acceptable values is “vår”, “höst”, “vall” & “träda” which denotes different crop types. “vår” is a spring sown annual crop. “höst” is a autumn sown annual crop, “vall” is a perennial in sown ley. “träda” is a fallow that is not sown. If it is the last year in the whole sequence the next crop is assumed to be “vår”.
  - “vår” Date is taken from table “Stubbearbetningstidpunkt”.
  - “höst” No stubble.
  - “vall” No stubble.
  - “träda” No stubble.
- **Stubbel eff** The efficiency of the stubble is taken from the table “Stubbeffektivitet”.
- **Plowing date** If the crop has a post crop it is not plowed. The plowing date depends on the following crop. Different routines for setting the sowing date are used depending on the value in column “Höst/vår” in table “Grödor” for the following crop. The four acceptable values is “vår”, “höst”, “vall” & “träda” which denotes different crop types. “vår” is a spring sown annual crop. “höst” is a autumn sown annual crop, “vall” is a perennial in sown ley. “träda” is a fallow that is not sown. If it is the last year in the whole sequence the next crop is assumed to be “vår”.
  - “vår” Date is taken from column “vårsådd” in table “Plöjningsstidpunkt”.
  - “höst” Date is taken from column “höstsådd” in table “Plöjningsstidpunkt”.
  - “vall” No plowing, unless the present crop is a fallow then the date is taken from table “PlöjningstidpunktInförVall”.
  - “träda” No plowing, unless the present crop is a fallow then the date is taken from column “w\_wheat\_upet3” in the table “Cupling” in the climate database. This value is the end of the growth period for winter wheat.If the crop is spring plowed without catch crop the date is taken from the column “Vårbearbetning utan insådd” in the table “Fånggröda plöjtid”. If it is the last crop in the dataset it can not be spring plowed, because the plowing would happen after the simulation end, in this case the crop is autumn sown as if the next crop is a spring sown crop.

If the crop has a post crop, spring or autumn plowed the plowing is done after the post crop.

An autumn plowed catch crop’s plow date is taken from the column “Insådd höstbearbetning” in the table “Fånggröda plöjtid”. A spring plowed catch crop’s plow date is taken from the column “Insådd vårbearbetning” in the table “Fånggröda plöjtid”. If the crop is the last in the dataset it is treated as an autumn plowed catch crop even if it was a spring plowed catch crop, otherwise the date will come after the end of the simulation period.
- **Fertilization date 1** The date for fertilization application depends on how the crop is defined in the column “Höst/vår” in table “Grödor”. The four acceptable values is “vår”, “höst”, “vall” & “träda” which denotes different crop types. “vår” is a spring sown annual crop. “höst” is a autumn sown annual crop, “vall” is a perennial in sown ley. “träda” is a fallow that is not sown.

- **“vår”** One day before the sow date. The offset in column “Handel vårsådd” in table “gödslingsoffset” is added to the date.
- **“höst”** For the four crops that have specified dates for the start of spring growing, in the coupling table in the climate database, (winter rye, winter wheat, winter rape and winter barley), the fertilization date is one day before that. Other autumn sown crops use the same date as winter wheat. This date can be modified by the offset in column “Handel höstsådd” in table “gödslingsoffset”.
- **“vall”** The ley is fertilized one day before the start of the growth season as defined in the coupling table in the climate database for ley. This date can be modified by the offset in column “Handel vall” in table “gödslingsoffset”.
- **“träda”** Not fertilized.
- **Fertilization NO3 1** The amount of NO<sub>3</sub> in the fertilization is taken from the column “NO3” in the table “Handelsgödsel 1”
- **Fertilization NH4 1** The amount of NH<sub>4</sub> in the fertilization is taken from the column “NH4” in the table “Handelsgödsel 1”
- **N-fixation NH4 1** If a fertilization date exists and is before June, the date is also used for the nitrogen fixation. If the fertilization date is after May the second Fertilization date is used. The amount of NH<sub>4</sub> is taken from the table “N-fix”. If it is the first year of the crop the amount is taken from the column “start”. If the crop is a ley the first and second year’s value is taken from column “start” and from third year, the value is taken from the column “liggande”. If the crop is green manure the value in column “liggande” is used from the second year.  
If no fertilization date exists the fixation is applied on the start of the growth season for ley as defined in the coupling table in the climate database.
- **Fertilization date 2** If a date exists in the table “Handelsgödseltidpunkt 2” for the present crop a second fertilization is applied on that date. If the date is after June it is applied as an autumn fertilization the year before.
- **Fertilization NO3 2** The amount of NO<sub>3</sub> in the fertilization is taken from the column “NO3” in the table “Handelsgödsel 2”
- **Fertilization NH4 2** The amount of NH<sub>4</sub> in the fertilization is taken from the column “NH4” in the table “Handelsgödsel 2”
- **N-fixation NH4 2** If a fertilization date exists and is before June, the date is also used for the nitrogen fixation. If the fertilization date is after May there is no suitable date for the fixation. The amount of NH<sub>4</sub> is taken from the table “N-fix”. If it is the first year of the crop the amount is taken from the column “start”. If the crop is a ley the first and second year’s value is taken from column “start” and from third year, the value is taken from the column “liggande”. If the crop is green manure the value in column “liggande” is used from the second year.  
If no fertilization date exists the fixation is applied on the start of the growth season for ley as defined in the coupling table in the climate database.
- **Manure date** Manure can be applied in the autumn or in the spring. The date for manure application depends on how the crop is defined in the column “Höst/vår” in table “Grödor”. The four acceptable values is “vår”, “höst”, “vall” & “träda” which denotes different crop types. “vår” is a spring sown annual crop. “höst” is a autumn sown annual crop, “vall” is a perennial in sown ley. “träda” is a fallow that is not sown.  
For spring applied manure, the date is calculated in the following way:
  - **“vår”** Two days before sowing the crop. This date can be modified by the offset in column “Stall vårsådd” in table “gödslingsoffset”.

- **“höst”** Two days the start of the growing season as defined for ley in the coupling table in the climate database. This date can be modified by the offset in column “Stall höstsådd” in table “gödslingsoffset”.
- **“vall”** Two days the start of the growing season as defined for ley in the coupling table in the climate database. This date can be modified by the offset in column “Stall vall” in table “gödslingsoffset”.
- **“träda”** No manure application.

For autumn applied manure, the date is calculated in the following way:

- **“vår”** The date is taken from table “stallgödselspridningstidpunkt”.
  - **“höst”** One day before sowing day for the crop.
  - **“vall”** The date is taken from table “stallgödselspridningstidpunkt”.
  - **“träda”** No manure application.
- **Manure amount** is set to 1.
  - **Manure type** is “Slurry, cattle”.
  - **Manure NH4** The amount of NH4 is taken from the column “NH4” in the table “Stallgödsel vår giva”
  - **Manure OrgN** The amount of OrgN is taken from the column “OrgN” in the table “Stallgödsel vår giva”
  - **Manure CN** Manure carbon:nitrogen ration is set to 20.
  - **Manure spreading** Manure spreading is set to "Broadc. spr."
  - **Manure incorp** In case of a spring spreading of manure, manure incorp is set to yes if there is a “ja” in the table “Manure Incorp vår” and to no if there is a “nej” in the same table. In the case of autumn spreading of manure the table “Manure Incorp höst” is used instead.
  - **Manure time incorp** If Manure incorp is yes then the Manure time incorp is set to 1 otherwise it is set to 0.
  - **Ley** Is set to “yes” if the crop is a ley or green manure, otherwise to “no”.
  - **Manure application loss** is set to 0.
  - **The complimentary fertilization** is added as a normal NO3 fertilization application. If both fertilization dates are used, the fertilization amount is added to the NO3 fertilization application on the date closest in time to the manure application date. The amount of fertilization is taken from the column “HandelsG” in the table “Stallgödsel vår giva”

## Catch crop - Soilndb 2.x

The catch crop is divided into three types; “Spring cultivated catch crop”, “Autumn cultivated catch crop” and “Spring cultivation without catch crop”. The catch crop in the later case is weeds and spilled seeds that germinate after harvest. The nitrogen uptake associated with each type of catch crop is taken from the Statistical database, and can be changed by the user to adapt the catch crop to a specific type.

Soils with high clay content are not normally cultivated in spring. In order to allow for this the actual amount of catch crops can be recalculated. The two spring cultivation practices are removed from clay soils and distributed among the other soils and on autumn cultivated catch crop on all soils, Tab. 1, according to the relative area of clay soils. The recalculating affects all the soils equally in the region i.e. not only those that have an area greater than zero. Two sets of catch crops are distributed in the internal crop sequence, with redistribution and without redistribution; this allows the user to use the same crop sequence without catch crop,

with catch crop and with redistributed catch crop when generating the SOILNDB input database.

*Tab. 1. Change in catch crop areas (ha) after recalculating the areas to avoid spring cultivation on clay soils. sccc = spring cultivated catch crop, accc = autumn cultivated catch crop, sc = spring cultivation, tot. = total area*

Org.	Spring barley	Winter wheat	Ley	Sugar beets	Winter rape	Fallow	Oats	Spring wheat	Winter rye	Winter barley	Spring rape	Potatoes
sccc	6164	2911	0	0	0	0	1420	1716	700	689	183	0
accc	4483	7278	0	0	0	0	1033	1830	350	424	46	0
sc	1121	485	0	0	0	0	387	229	156	212	46	0
tot.	11768	10674	0	0	0	0	2840	3775	1206	1325	275	0
Sand												
sccc	7688	3631	0	0	0	0	1771	2140	873	859	228	0
accc	5591	9077	0	0	0	0	1288	2282	437	529	57	0
sc	1398	605	0	0	0	0	483	286	195	264	57	0
tot.	14677	13313	0	0	0	0	3542	4708	1505	1652	342	0
Clay												
sccc	0	0	0	0	0	0	0	0	0	0	0	0
accc	5591	9077	0	0	0	0	1288	2282	437	529	57	0
sc	0	0	0	0	0	0	0	0	0	0	0	0
tot.	5591	9077	0	0	0	0	1288	2282	437	529	57	0

### Catch crop - Soilndb 3.x

The catch crop is divided into three types; “Spring cultivated catch crop”, “Autumn cultivated catch crop” and “Spring cultivation without catch crop”. The catch crop in the later case is weeds and spilled seeds that germinate after harvest. The nitrogen uptake associated with each type of catch crop is calculated in Soilndb 3.0 during simulation. No distribution of catch crops over different soils is implemented.

### Nitrogen fixation - Soilndb 2.x

Nitrogen fixation is treated as an addition to fertilization in SOILNDB. For leys a specified amount of nitrogen, given in the statistical database, is added to the nitrogen fertilization. For other crops capable of nitrogen fixation, the amount of nitrogen added to fertilization is calculated as the difference between added nitrogen and nitrogen needed to reach the target harvest. This is automatically calculated and not visible to the user.

### Nitrogen fixation - Soilndb 3.x

In Soilndb 3.x fixation is treated as ammonium fertilization. Two fixations can be “applied” to each harvest. The statistical database contains sheets with fixation for up to four harvests and for the autumn fixation of undersown leys and green manure leys. Any crop can have fixation. No fixation is calculated as it is when saving a soilndb 2.x database.

### Maximum harvest

The simulated harvest should be as close as possible to the given target harvest. If the maximum harvest in the model is equal to the given target harvest this would not be possible, as the simulated harvest would be smaller some years due to nitrogen deficiency in the soil.

In order for the model to reach the given target harvest in average the concept of maximum harvest is used. This allows the model to simulate a larger harvest than the target harvest some years. The maximum harvest value is calculated from the target harvest +10%, this factor is defined in the statistical database in the grödor table.

## Nitrogen deposition

Nitrogen deposition is divided in two parts, wet and dry deposition. The dry deposition is a load (kg/ha/year). The wet deposition is a load (kg/ha/year) in the statistical database but a concentration (mg/l) in the SOILNDB input database. The wet deposition is recalculated using a yearly mean value of precipitation calculated from the climate database. The precipitation is corrected using the preca0 value in the climate database. If the air temperature is below 0 degrees the preca0 (rain) value and the preca1 (snow) value is used.

## Second harvest of leys - Soilndb 2.x

The ley has a second harvest. Only the date for harvest is given as input. The given harvest is divided in 2 parts,  $\frac{2}{3}$  of the total harvest is the first harvest and  $\frac{1}{3}$  is the second harvest.

## Several harvests per year - Soilndb 3.x

Ley and green manure can have several harvests per year. The dates for the harvests and the harvest in kg/ha is entered in the statistical database.

## ***Additional tables in the input database for SOILNDB***

Besides the cropping system table that contains the crop sequence and the management of the crops, the database also contains a few other tables:

The SOILNDB input database contains 8 tables, Tab. 2.

*Tab. 2. The tables in the SOILNDB input database.*

<i>Table name</i>	<i>Use</i>
CatchCrop	Statistical information about the catch crop
Cropping system	The crop sequence and management
Deposition	Atmospheric deposition of nitrogen
Extra	Some extra information about used databases
Hydrology	Hydrological model settings
ID number	Dataset number and used climate database
Soil data	Soil class and organic matter content
Version	Version of Soilndb that should be used with the database

## ***The statistics database***

The statistics database contains all the information needed to construct the cropping system database, except climate data. The database is a MS Excel workbook with one table per sheet (Table 1). The names of most of the sheets are in Swedish as are some of the column headings. The statistics database also contains some information that is not really statistical data, but placed in the same database for practical purposes. The tables are presented in

alphabetical order. Most of the tables are abbreviated to save space and make the text more readable.

Table 1. The tables in the statistical database.

Excel sheet name	Description of content	Unit	SOILNDB 2.x	SOILNDB 3.x	ICECREAMDB 1.x	ADC
Fånggröda areal	Area of catch crop	(ha)	x	x	x	
Fånggröda plöjtid	Tillage date for catch crops	(date)		x	x	
Grödoareal	Crop area	(ha)	x	x	x	
Grödor	A collection of switches affecting the crops		x	x	x	
Gröngödslingsvallängd	The percentage distribution of the number of years the green fallow lays	(%)		x	x	
gödslingsoffset	An offset added to the normal date for the application of manure and chemical fertilizer	(days)		x		
Halmskördad areal %	Area where straw is removed	(%)	x	x	x	
Handelsgödsel 1	Amount of chemical NO3 and NH4 fertilization applied, first application	(kg/ha)	x	x	x	
Handelsgödsel 2	Amount of chemical NO3 and NH4 fertilization applied, second application	(kg/ha)		x		
Handelsgödseltidpunkt 2	Date for the second application of chemical fertilizer	(date)		x		
Jordarter	Soil names and clay info	(-)	x	x	x	
Jordartsfördelning	The proportion of the soils per region	(%)	x	x	x	
JordBearTidHöstBearbFånggröda	Tillage date for autumn cultivated catch crop	(date)	x			
KärnN	Content of N in harvested biomass (grain, seeds, roots etc)	(% dm)	x	x	x	
Manure Incorp höst	Switch: Manure incorporated when applied in the autumn	(-)	x	x		
Manure Incorp vår	Switch: Manure incorporated when applied in the spring	(-)	x	x		
Målavrinning	Target discharge for water	(mm)				x
N-dep	Atmospheric deposition of nitrogen	(kg/ha)	x	x		
N-fix	Nitrogen fixation during the period till the first harvest	(kg/ha)	x	x		
N-fix0	Nitrogen fixation during the autumn in the sowing year	(kg/ha)		x		
N-fix2	Nitrogen fixation during the period till the second harvest	(kg/ha)		x		
N-fix3	Nitrogen fixation during the period till the third harvest	(kg/ha)		x		
N-fix4	Nitrogen fixation during the period after the third harvest	(kg/ha)		x		
Områden	The names of the defined regions	(-)	x	x	x	
OrganiskHalt	Soil organic content	(%)	x	x		
P depth comp handel	Application depth of complimentary application of P fertilizater	(mm)			x	
P depth handel	Application depth of application of P fertilizater	(mm)			x	
P depth manure	Application depth of manure	(mm)			x	
P Handel giva 1	Amount of chemical P fertilization applied, first application	(kg/ha)			x	
P Handel giva 2	Amount of chemical P fertilization applied, first application	(kg/ha)			x	
P Harvest catchcrop					x	
P Manure	Amount of organic matter, P manure and P chemical fertilization	(kg/ha)			x	

Excel sheet name	Description of content	Unit	SOILNDB 2.x	SOILNDB 3.x	ICECREAMDB 1.x	ADC
P Manure summer	Amount of organic matter, P manure and P chemical fertilization, summer application	(kg/ha)			X	
P NP	Ratio Nitrogen Phosphorus in harvested biomass	(-)			X	
P NP catchcrop	Ratio Nitrogen Phosphorus in catch crop	(-)			X	
P remove residues	Proportion of harvest residues removed when residues are removed	(%)			X	
Plöjningsstidpunkt	Tillage date	(date)	X	X	X	
PlöjningsstidpunktInförVall	Tillage date before lays if lay is spring sown	(date)	X	X		
PotentielltFånggrödeUpptag	Potential uptake of N by catch crop	(kg/ha)	X			
Procentuell bortförsel av skörd	Percentage of harvest that is removed from the field	(%)		X		
Reduction	Reduction of water and phosphorus that leaves the field	(hundreds)			X	
ResterN	Content of N in non harvested biomass	(% dm)		X		
Skörd	First harvest	(kg/ha)	X	X		
Skörd Icecream	Harvest	(g/m2)			X	
Skörd2	Second harvest	(kg/ha)		X		
Skörd3	Third harvest	(kg/ha)		X		
Skördtid	First harvest date	(date)	X	X	X	
Skördtid2	Second harvest date	(date)	X	X		
Skördtid3	Third harvest date	(date)		X		
slope (%)	Slope, length and width of field	(% & m)			X	
SoilP	Phosphorus amount in soil	(g P/kg soil)			X	
Stallgödsel areal %	Area manure is applied on of total crop area	(%)	X	X	X	
Stallgödsel höst %	Percentage of manured areas that has autumn application	(%)	X	X	X	
Stallgödsel höst giva	Amount of manure N applied in autumn	(kg/ha)	X	X	X	
Stallgödsel sommar %	Percentage of manured areas that has summer application	(%)			X	
Stallgödsel vår giva	Amount of manure N applied in spring	(kg/ha)		X	X	
stallgödselspridningstidpunkt	Manure application N date	(date)	X	X		
stallgödselspridningstidpunkt 2	Not used					
Stubbearbetningstidpunkt	Date for stubbling	(date)		X		
Stubbefektivitet	Efficiency of stubbling	(%)		X		
Såtid	Sowing date	(date)	X	X	X	
Vallängd	The percentage of the number of years the leys lays	(%)		X	X	

**Fånggröda areal** contains the area (ha) of each crop that has; a spring plowed catch crop (Insådd vårbearbetning); an autumn plowed catch crop (Insådd höstbearbetning); or is spring plowed without catch crop (Vårbearbetning utan insådd). The proportions are used in the construction of the crop sequence.

Område	Spring_ barley Insådd vårbear betning	Spring_ barley Insådd höstbear betning	Spring_ barley Vårbear betning utan insådd	Winter_ wheat Insådd vårbear betning	Winter_ wheat Insådd höstbear betning	Winter_ wheat Vårbear betning utan insådd	Ley Insådd vårbear betning	Ley Insådd höstbear betning	Ley Vårbear betning utan insådd
po1a	118.52	20.17	1.39	8.67	23.1	0	0	0	0
po1b	83.57	12.59	13.15	10.35	16.06	0	0	0	0
po2a	210.54	9.73	15.23	67.5	16.2	0	0	0	0
po2b	29.7	4.2	23	0	0	0	0	0	0

**Fånggröda plöjtid** contains the dates for soil cultivation if the crop has; a spring plowed catch crop (Insådd vårbearbetning); an autumn plowed catch crop (Insådd höstbearbetning); or is spring plowed without catch crop (Vårbearbetning utan insådd).

Område	Spring_ barley Insådd vårbear betning	Spring_ barley Insådd höstbear betning	Spring_ barley Vårbear betning utan insådd	Winter_w heat Insådd vårbear betning	Winter_ wheat Insådd höstbear betning	Winter_ wheat Vårbear betning utan insådd	Ley Insådd vårbear betning	Ley Insådd höstbear betning	Ley Vårbear betning utan insådd
po1a	08-Apr	20-Nov	08-Apr	08-Apr	20-Nov	08-Apr			
po1b	08-Apr	20-Nov	08-Apr	08-Apr	20-Nov	08-Apr			
po2a	11-Apr	20-Nov	11-Apr	11-Apr	20-Nov	11-Apr			
po2b	11-Apr	20-Nov	11-Apr	11-Apr	20-Nov	11-Apr			

**Grödoareal** contains the area of each crop for different regions, where the column Areal (ha) contains the total area for all crops in the region. This table is the basis for the whole crop sequence as the crops are distributed according to their proportion in this table.

Område	Areal	Spring_barley	Winter_wheat	Ley
po1a	198458	71107	84378	42964
po1b	198458	71107	84378	42964
po2a	1000	1000	0	0
po2b	1000	1000	0	0

**Grödor** contains some basic information about the crops

(Gröda) is the defined crop names in this database.

(Höst/vår) is the sowing time, höst = autumn, vår = spring, vall = insown ley, träda = fallow (not sown).

(Engelskt namn)\* is the names of the crops in the SOILNDB model.

(N-Fix)\* A switch defining if a crop can fixate atmospheric nitrogen or not. Ja = yes and Nej = no.

(Max Skör Korr)\* A factor which is multiplied with the harvest to calculate the maximal simulated harvest.

(Stråsäd) is a switch defining a crop as a cereal or not. Ja = yes, Nej = no. Used by one of the conditions during randomization.

(Sekundär namn)\* The name of the crop during subsequent years. Used for perennial crops.

(ICECREAM)<sup>+</sup> is the names of the crops as they are defined in ICECREAM.

(Harvest)<sup>+</sup> If the crop is harvested or not, yes or no.

\* SOILNDB only

<sup>+</sup>ICECREAM only

Gröda	Höst/vår	Engelskt namn	N-Fix	Max Skörd korr	Stråsäd	Sekundär namn	Icecream	Harvest
Spring_barley	vår	Spring_barley	Nej	1.1	Ja		s_barley	yes
Winter_wheat	höst	Winter_wheat	Nej	1.1	Ja		w_wheat	yes
Ley	vall	Ley, >25% Clov	Ja	1.1	Nej	Ley, <25% Clov	Ley	yes
Sugar_beets	vår	Sugar_beets	Nej	1.1	Nej		su_beet	yes
Winter_rape	höst	Winter_rape	Nej	1.1	Nej		w_rape	yes
Green_manure	vall	Green_manure	ja	1.1	Nej	Ley, Green Manure	fallow_gr	no
Stubble_fallow	träda	Stubble_fallow	Nej	1.1	nej		fallow_st	no

**Gröngödslingsvallängd** contains the proportion of green manure that lies for a certain number of years. år = year.

Område	1 år %	2 år %	3 år %	4 år %
po01a	10	15	75	0
po01b	10	15	65	10
po02a	10	15	75	0
po02b	10	15	60	5

**Gödslingsoffset** is a SOILNDB only property for shifting the application of fertilizer and manure in relation to the normal application date. Number of days.

Handel = chemical fertilizer. Stall = manure. vårsådd = spring sowing. höstsådd = autumn sowing. vall = ley.

Område	Handel vårsådd	Handel höstsådd	Handel vall	Stall vårsådd	Stall höstsådd	Stall vall
po01a	0	0	0	0	0	0
po01b	0	0	0	0	0	0
po02a	0	0	0	0	0	0
po02b	0	0	0	0	0	0

**Halmskördad areal %** contains the percentage of crop area where straw is removed (i.e. harvested).

Område	Spring_barley	Winter_wheat
po01a	41.00	35.00
po01b	41.00	35.00
po02a	74.00	56.00
po02b	74.00	56.00

**Handelsgödsel 1** The application in (kg/ha) of NO<sub>3</sub> and NH<sub>4</sub> for all crops.

Område	Spring_barley NO3	Spring_barley NH4	Winter_wheat NO3	Winter_wheat NH4	Ley NO3	Ley NH4
po01a	75	75	75	75	75	75
po01b	75	75	75	75	75	75
po02a	75	75	75	75	75	75
po02b	75	75	75	75	75	75

**Handelsgödsel 2** The second application in (kg/ha) of NO<sub>3</sub> and NH<sub>4</sub> for all crops. It is only applied if there is a date in *Handelsgödsetidpunkt 2*.

Område	Spring_barley NO3	Spring_barley NH4	Winter_wheat NO3	Winter_wheat NH4	Ley NO3	Ley NH4
po01a	75	75	75	75	75	75
po01b	75	75	75	75	75	75
po02a	75	75	75	75	75	75
po02b	75	75	75	75	75	75

**Handelsgödsetidpunkt 2** the date of the application of the second fertilization with NO<sub>3</sub> or NH<sub>4</sub>. An empty cell means that there is no second application of fertilizer.

Område	Spring_barley	Winter_wheat	Ley	Sugar_beets
po01a				
po01b				
po02a				
po02b				

**Jordarter** contains the names of the soil texture classes defined in ICECREAM and SOILNDB. The Jord (soil) column contains the standard soil names. If the soil is considered a clay there is a ja (yes) in the Lera (clay) column otherwise a nej (no). P-Fert, P-Manure and P-Mixing contain the names of the soils, in ICECREAM, defined for use with a pure mineral fertilization, a pure manure application and for mixed conditions.

Jord	Lera	P-Fert	P-Manure	P-Mixed
Sand	nej	S01F-Sand	S01M-Sand	S01F-Sand
Loamy sand	nej	S02F-LoamySand	S02M-LoamySand	S02F-LoamySand
Sandy loam	nej	S03F-SandyLoam	S03M-SandyLoam	S03F-SandyLoam
Loam	nej	S04F-Loam	S04M-Loam	S04F-Loam
Silt loam	nej	S05F-SiltyLoam	S05M-SiltyLoam	S05F-SiltyLoam
Sandy clay loam	ja	S06F-SandyClayLoam	S06M-SandyClayLoam	S06F-SandyClayLoam
Clay loam	ja	S07F-ClayLoam	S07M-ClayLoam	S07F-ClayLoam
Silty clay loam	ja	S08F-SiltyClayLoam	S08M-SiltyClayLoam	S08F-SiltyClayLoam
Silty clay	ja	S09F-SiltyClay	S09M-SiltyClay	S09F-SiltyClay
Clay	ja	S10F-Clay	S10M-Clay	S10F-Clay

**Jordartsfördelning** contains the proportion of different soils in different regions. This is used in two ways, to see what soils are present and therefore needs to be included in the simulation and after the simulation the result can be weighted in proportion to the extent of different soils in the region.

Område	Sand	Loamy sand	Sandy loam	Loam	Silt loam	Sandy clay loam	Clay loam	Silty clay loam	Silty clay	Clay
po01a	0.00	0.00	0.72	0.25	0.00	0.03	0.00	0.00	0.00	0.00
po01b	0.00	0.11	0.71	0.18	0.00	0.00	0.00	0.00	0.00	0.00
po02a	0.00	0.07	0.71	0.22	0.00	0.00	0.00	0.00	0.00	0.00
po02b	0.03	0.08	0.67	0.19	0.02	0.01	0.00	0.00	0.00	0.00

**JordbearTidHöstBearbFånggröda** is SOILNDB 2.x only. This is the soil cultivation date for crops with catchcrops that are cultivated in the autumn.

Område	Spring_barley	Winter_wheat	Ley	Sugar_beets
po01a	25-Oct	25-Oct		
po01b	25-Oct	25-Oct		
po02a	25-Oct	25-Oct		
po02b	25-Oct			

**KärnN** The concentration of N (% dry matter) in the harvested part of the crop.

Område	Spring_barley	Winter_wheat	Ley	Sugar_beets
po01a	2	1.7	3	0.8
po01b	2	1.7	3	0.8
po02a	2	1.7	3	0.8
po02b	2	1.7	3	0.8

**Manure Incorp höst** Whether manure applied in the autumn should be incorporated in the soil or not. Ja = yes, Nej = no.

Område	Spring_barley	Winter_wheat	Ley	Sugar_beets
po01a	Ja	Ja	Nej	
po01b	Ja	Ja	Nej	
po02a	Ja	Ja	Nej	
po02b	Ja	Ja	Nej	

**Manure Incorp vår** Whether manure applied in the spring should be incorporated in the soil or not. Ja = yes, Nej = no.

Område	Spring_barley	Winter_wheat	Ley	Sugar_beets
po01a	Ja	Nej	Nej	
po01b	Ja	Nej	Nej	
po02a	Ja	Nej	Nej	
po02b	Ja	Nej	Nej	

**Målavrinning** is the runoff in mm for each region (Område). This table is not used by CSMG but by a program that is used to calibrate the runoff in SOILNDB to these values. The target runoff is very important because the amount of water that passes through the model affects the results.

Område	(mm)
po01a	288
po01b	445
po02a	312
po02b	190

**N-dep** is the deposition of N as wet (Våt dep) deposition and dry (Torr dep) deposition in Kg N/ha and year.

Område	Våt dep (kg/ha/år)	Torr dep (kg/ha/år)
po01a	9.2	3
po01b	12	3
po02a	9.5	3
po02b	6.2	2

***N-fix*** The nitrogen fixation during the growth period for the first harvest (kg/ha). Start is the starting year of the crop. liggande is the subsequent years for a perennial crop.

Område	Spring_barley start	Spring_barley liggande	Ley start	Ley liggande	Peas start	Peas liggande	Horse_bean start	Horse_bean liggande
po01a			52	21	62		90	
po01b			52	21	62		88	
po02a			56	22	62		90	
po02b			56	22	64		91	

***N-fix0*** The nitrogen fixation during the autumn after sowing for autumn sown crops and leys.

Område	Spring_barley	Winter_wheat	Ley	Sugar_beets
po01a				
po01b				
po02a				
po02b				

***N-fix2, N-fix3, N-fix4*** The nitrogen fixation during the growth period for the second, third harvest, and after the third harvest (kg/ha). Start is the starting year of the crop. liggande is the subsequent years for a perennial crop.

Område	Spring_barley start	Spring_barley liggande	Ley start	Ley liggande	Peas start	Peas liggande	Horse_bean start	Horse_bean liggande
po01a			52	21				
po01b			52	21				
po02a			56	22				
po02b			56	22				

***Områden*** contains a list of the regions defined in the statistics database. This is a base table that defines which regions that should exist in all the other tables.

Område
po01a
po01b
po02a
po02b

***OrganiskHalt*** contains the soil organic content for the topsoil and subsoil for all soils.

Område	Sand	Sand	Loamy sand	Loamy sand	Sandy loam	Sandy loam
	Topsoil	Subsoil	Topsoil	Subsoil	Topsoil	Subsoil
po01a	5.10	0.1	5.10	0.1	5.10	0.1
po01b	5.10	0.1	5.10	0.1	5.10	0.1
po02a	5.10	0.1	5.10	0.1	5.10	0.1
po02b	5.10	0.1	5.10	0.1	5.10	0.1

***P depth comp handel*** contains the complementary mineral fertilizer application depth (mm). This controls to which computational layer in ICECREAM the mineral phosphorus is added.

Område	Spring_barley	Winter_wheat	Ley	Sugar_beets
po01a	70	0	0	15
po01b	70	0	0	15
po02a	70	0	0	15
po02b	70	0	0	15

**P depth handel** contains the mineral fertilizer application depth (mm). This controls to which computational layer in ICECREAM the mineral phosphorus is added.

Område	Spring_barley	Winter_wheat	Ley	Sugar_beets
po01a	70	0	0	15
po01b	70	0	0	15
po02a	70	0	0	15
po02b	70	0	0	15

**P depth manure** contains the manure application depth (mm). This controls to which computational layer in ICECREAM the manure phosphorus is added.

Område	Spring_barley	Winter_wheat	Ley	Sugar_beets
po01a	70	70	0	0
po01b	70	70	0	0
po02a	70	70	0	0
po02b	70	70	0	0

**P Handel giva 1** contains the P content (kg/ha) applied with mineral fertilizer. The 1 in the table name is a preparation for further development with several fertilizations per year.

Område	Spring_barley	Winter_wheat	Ley	Sugar_beets
po01a	7.7	14	12	28
po01b	7.7	14	12	28
po02a	8.6	13	11	17
po02b	8.6	13	11	17

**P Handel giva 2** contains the P content (kg/ha) applied with mineral fertilizer. The 2 in the table name is a preparation for further development with several fertilizations per year. Not presently used.

Område	Spring_barley	Winter_wheat	Ley	Sugar_beets
po01a				
po01b				
po02a				
po02b				

**P Harvest catchcrop** The harvest of catchcrop in ICECREAMDB (g/m<sup>2</sup>).

	catchcrop
po01a	0.18
po01b	0.18
po02a	0.18
po02b	0.18

**P manure** contains the applied amount of organic matter (kg/ha) with manure and the P content (kg/ha) in manure. The same amount will be applied regardless of it is done in spring or autumn. The manured crops receive a complimentary mineral fertilizer application (kg/ha), HandelsG.

Område	Spring_barley	Spring_barley	Spring_barley	Winter_wheat	Winter_wheat	Winter_wheat	Ley	Ley	Ley
	OrgMtr	P manure	HandelsG	OrgMtr	P manure	HandelsG	OrgMtr	P manure	HandelsG
po01a	5	20	10	5	25	15	3	25	15
po01b	5	20	10	5	25	15	3	25	15
po02a	5	20	10	5	25	15	3	25	15
po02b	5	20	10	5	25	15	3	25	15

**P Manure summer** contain the manure application in the summer given to ley after the first harvest. Due to technical reasons, all crops are present in the table. It is not possible to add an extra mineral fertilization, HandelsG, to the summer manure event.

Område	Spring_ barley OrgMtr	Spring_ barley P manure	Spring_ barley HandelsG	Winter_ wheat OrgMtr	Winter_ wheat P manure	Winter_ wheat HandelsG	Ley OrgMtr	Ley P manure	Ley HandelsG
po01a							1	10	
po01b							1	10	
po02a							1	10	
po02b							1	10	

**P NP** The N to P ratio of the yield.

	Spring_barley	Winter_wheat	Ley	Sugar_beets
po01a	3.53	4	2.52	8.74
po01b	3.53	4	2.52	8.74
po02a	3.53	4	2.52	8.74
po02b	3.53	4	2.52	8.74

**P NP** The N to P ratio of the catch crop yield.

	catchcrop
po01a	2.52
po01b	2.52
po02a	2.52
po02b	2.52

**P remove residues** contains the proportion of P in residues that is removed with straw.

Område	Spring_barley	Winter_wheat	Ley	Sugar_beets
po01a	0.16	0.16	0	0
po01b	0.16	0.16	0	0
po02a	0.16	0.16	0	0
po02b	0.16	0.16	0	0

**Plöjningstidpunkt** contains the dates for soil cultivation in autumn. The table contains separate columns dates depending on if the following crop is autumn sown (höstsådd) or spring sown (vårsådd).

Område	Spring_ barley höstsådd	Spring_ barley vårsådd	Winter_ wheat höstsådd	Winter_ wheat vårsådd	Ley höstsådd	Ley vårsådd	Sugar_ beets höstsådd	Sugar_ beets vårsådd
po01a	22-aug	09-okt	15-sep	09-okt	22-aug	09-okt		02-nov
po01b	22-aug	09-okt	15-sep	09-okt	22-aug	09-okt		02-nov
po02a	22-aug	08-okt	16-sep	08-okt	22-aug	08-okt		02-nov
po02b	22-aug	08-okt	16-sep	08-okt	22-aug	08-okt		02-nov

**PlöjningstidpunktInförVall** contains dates for soil cultivation before a spring sown ley. The ley is normally insown in the preceding crop, but after green manure and leys that have laid to long the ley is spring sown.

Område	Spring_barley	Winter_wheat	Ley	Sugar_beets
po01a	20-aug	02-sep	09-okt	
po01b	20-aug	02-sep	09-okt	
po02a	21-aug	26-aug	08-okt	
po02b	21-aug	26-aug	08-okt	

**PotentielltFånggrödeUpptag** contains the uptake of N (kg/ha) from the catch crop. Only used for SOILNDB 2.x. Insådd vårbearbetning is spring cultivated insown catch crop. Insådd höstbearbetning is autumn cultivated insown catch crop. Vårbearbetning utan insådd is spring cultivation without sown catch crop. Höstsådd is before a autumn sown crop, vårsådd is before a spring sown crop.

Område	Insådd vårbearbetning höstsådd	Insådd vårbearbetning vårsådd	Insådd höstbearbetning höstsådd	Insådd höstbearbetning vårsådd	Vårbearbetning utan insådd höstsådd	Vårbearbetning utan insådd vårsådd
po01a	37	50	20	27	24	24
po01b	41	55	23	30	24	24
po02a	37	50	20	27	24	24
po02b	41	55	23	30	24	24

**Procentuell bortförel av skörd** is the percentage of the harvest that is removed from the field.

Område	Spring_barley	Winter_wheat	Ley	Sugar_beets
po01a	100	100	100	100
po01b	100	100	100	100
po02a	100	100	100	100
po02b	100	100	100	100

**Reduction** contain the reduction (0-1) of losses of solute P (rolp) and particle P (sedp) via surface runoff and drainage losses of solute P (pleach) and particle P (drainpp) and surface runoff of and drainage water. This is used to account for losses between the field and the receiving water way, and retention in field-adjacent open ditches, where sediments (including P) are removed through ditch cleaning.

Område	Rolp	Sedp	Pleach	DrainPP	dayrun	DrainWater
po1a	0.75	0.75	0.25	0.25	0.75	0.25
po1b	0.75	0.75	0.25	0.25	0.75	0.25
po2a	0.75	0.75	0.25	0.25	0.75	0.25
po2b	0.75	0.75	0.25	0.25	0.75	0.25

**ResterN** The concentration of N (% dry matter) in the harvest residues.

Område	Spring_barley	Winter_wheat	Ley	Sugar_beets
po01a	1	1	2	2.25
po01b	1	1	2	2.25
po02a	1	1	2	2.25
po02b	1	1	2	2.25

**Skörd** contains the harvest for SOILNDB in kg/ha, at standard water content, defined in the parameter database. Höstsådd is autumn sown and vårsådd is spring sown, these are not applicable in all crops.

Område	Spring_barley höstsådd	Spring_barley vårsådd	Winter_wheat höstsådd	Winter_wheat vårsådd	Ley höstsådd	Ley vårsådd
po01a	5 711	5 711	8 039	8 039	5831	5831
po01b	5 711	5 711	8 039	8 039	5831	5831
po02a	5 114	5 114	7 180	7 180	5721	5721
po02b	5 114	5 114	7 180	7 180	5721	5721

**Skörd Icecream** contains the crop yield (g/m<sup>2</sup>). The yield together with nitrogen/phosphorus proportions is used in ICECREAM to calculate the amount of crop uptake of phosphorus from the soil, and the amount exported with the crop.

	Spring_barley	Winter_wheat	Ley	Sugar_beets
po01a	0.58090	0.77520	0.99870	4.30000
po01b	0.58090	0.77520	0.99870	4.30000
po02a	0.58090	0.77520	0.99870	4.30000
po02b	0.58090	0.77520	0.99870	4.30000

**Skörd 2** the second harvest (kg/ha) for SOILNDB 3.x.

Område	Spring_barley	Winter_wheat	Ley	Sugar_beets
po01a			2915	
po01b			2915	
po02a			2860	
po02b			2860	

**Skörd 3** the third harvest (kg/ha) for SOILNDB 3.x.

Område	Spring_barley	Winter_wheat	Ley	Sugar_beets
po01a			2915	
po01b			2915	
po02a			2860	
po02b			2860	

**Skördtid** contains harvest dates for the first harvest.

Område	Spring_barley	Winter_wheat	Ley	Sugar_beets
po01a	19-aug	01-sep	15-jun	01-nov
po01b	19-aug	01-sep	15-jun	01-nov
po02a	20-aug	25-aug	15-jun	01-nov
po02b	20-aug	25-aug	15-jun	01-nov

**Skördtid2** contains dates for the second harvest of ley. Ley is the only crop with two harvests per growing season.

Område	Spring_barley	Winter_wheat	Ley	Sugar_beets
po01a			15-aug	
po01b			15-aug	
po02a			15-aug	
po02b			15-aug	

**Skördtid3** contains dates for the third harvest of ley. Ley is the only crop with three harvests per growing season. Only SOILNDB 3.x.

Område	Spring_barley	Winter_wheat	Ley	Sugar_beets
po01a				
po01b				
po02a				
po02b				

**Slope (%)** contain the slope for three classes in %, and the length and width of the field in m. Slope is a very important parameter for surface losses of phosphorus.

Område	Low	Medium	Steep	Length	Width
po01a	0.5	1.5	4.5	50	100
po01b	0.5	1.5	4.5	50	100
po02a	0.5	1.5	4.5	50	100
po02b	0.5	1.5	4.5	50	100

**SoilP** contain the amount of SoilP (g P/kg soil) for three classes and four soil layers. SoilP is an important parameter for the phosphorus losses through the soil and for surface losses.

Område	layer1	layer1	layer1	layer2	layer2	layer2	layer3	layer3	layer3	layer4	layer4	layer4
	Low	Medium	High	Low	Medium	High	Low	Medium	High	Low	Medium	High
po01a	0.75	1.5	3	0.75	1.5	3	0.4	0.8	1.6	0.4	0.8	1.6
po01b	0.75	1.5	3	0.75	1.5	3	0.4	0.8	1.6	0.4	0.8	1.6
po02a	0.75	1.5	3	0.75	1.5	3	0.4	0.8	1.6	0.4	0.8	1.6
po02b	0.75	1.5	3	0.75	1.5	3	0.4	0.8	1.6	0.4	0.8	1.6

**Stallgödsel areal %** contains the percentage of crop area that will receive manure.

Område	Spring_barley	Winter_wheat	Ley	Sugar_beets
	Areal %	Areal %	Areal %	Areal %
po01a	31	18	69	19
po01b	31	18	69	19
po02a	41	72	82	47
po02b	41	72	82	47

**Stallgödsel höst** contains the percentage of the area that receives manure in autumn.

Område	Spring_barley	Winter_wheat	Ley	Sugar_beets
po01a	6	82	18	50
po01b	6	82	18	50
po02a	11	70	26	23
po02b	11	70	26	23

**Stallgödsel höst giva** Amount of manure N and complementary chemical fertilizer given in autumn (kg/ha).

Område	Spring_barley	Spring_barley	Spring_barley	Winter_wheat	Winter_wheat	Winter_wheat
	NH4	OrgN	HandelsG	NH4	OrgN	HandelsG
po01a	75	75	0	75	75	0
po01b	75	75	0	75	75	0
po02a	75	75	0	75	75	0
po02b	75	75	0	75	75	0

**Stallgödsel sommar %** contains the percentage of the area that receives manure in summer. Only ICECREAMDB.

Område	Spring_barley	Winter_wheat	Ley	Sugar_beets
po01a	0	0	36	0
po01b	0	0	36	0
po02a	0	0	25	0
po02b	0	0	25	0

**Stallgödsel vår giva** Amount of manure N and complementary chemical fertilizer given in spring (kg/ha).

Område	Spring_barley NH4	Spring_barley OrgN	Spring_barley HandelsG	Winter_wheat NH4	Winter_wheat OrgN	Winter_wheat HandelsG
po01a	75	75	0	75	75	0
po01b	75	75	0	75	75	0
po02a	75	75	0	75	75	0
po02b	75	75	0	75	75	0

**Stallgödelspridningstidpunkt** Date for spreading of manure in the autumn for SOILNDB only. Spring dates are calculated as are all dates for ICECREAMDB.

Område	Spring_barley	Winter_wheat	Ley	Sugar_beets
po01a	14-nov		03-nov	14-nov
po01b	14-nov		03-nov	14-nov
po02a	14-nov		14-nov	14-nov
po02b	14-nov		14-nov	14-nov

**Stallgödelspridningstidpunkt 2** Date for second spreading of manure not used.

Område	Spring_barley	Winter_wheat	Ley	Sugar_beets
po01a				
po01b				
po02a				
po02b				

**Stubbearbetningstidpunkt** Date for stubbling. Normally only before spring sown crops, vårsådd, to short time otherwise. Höstsådd = autumn sown crop.

Område	Spring_barley höstsådd	Spring_barley vårsådd	Winter_wheat höstsådd	Winter_wheat vårsådd	Ley höstsådd	Ley vårsådd
po01a		02-sep		15-sep	17-aug	15-sep
po01b		02-sep		15-sep	17-aug	15-sep
po02a		03-sep		08-sep	17-aug	15-sep
po02b		03-sep		08-sep	17-aug	15-sep

**Stubbeffektivitet** Efficiency of stubbling in percentage.

Område	Spring_barley	Winter_wheat	Ley	Sugar_beets
po01a	25	25	25	25
po01b	25	25	25	25
po02a	25	25	25	25
po02b	25	25	25	25

**Såtid** contains sowing dates.

Område	Spring_barley	Winter_wheat	Ley	Sugar_beets
po01a	08-apr	22-sep	15-jun	13-apr
po01b	08-apr	22-sep	15-jun	13-apr
po02a	09-apr	23-sep	15-jun	13-apr
po02b	09-apr	23-sep	15-jun	13-apr

**Vallängd** contains the percentage of leys that lies for one to 4 years. An alternative to this is to give the ley lengths in the user interface before the randomization.

Område	1 år %	2 år %	3 år %	4 år %
po1a	19.48	32.47	37.66	10.39
po1b	19.48	32.47	37.66	10.39
po2a	19.48	32.47	37.66	10.39
po2b	19.48	32.47	37.66	10.39

### **The crop sequence database**

The crop sequence database is a MS Access database with 4 tables, se Tab. 3 for short description.

*Tab. 3. The tables in the crop sequence database*

<i>Table name</i>	<i>Use</i>
CatchCrop	Catch crop statistics
Conditions	The conditions for the randomization and the number of errors in the randomization
Inställningar	The settings for the randomization
slump	The randomized crop sequence, including catch crops

**CatchCrop** contains information about the amount of potential and actual catchcrops in the system. This table is no longer used.

Crop	Pot_ Catchcrop	Pot_ CatchcropMod	Act_ Catchcrop	Act_ CatchcropMod	Act_ CatchcropClay	Act_ CatchcropClayMod
Green_manure	0	0	0	0	0	0
Horse_bean	0	0	0	0	0	0
Ley	0	0	0	0	0	0
Maize	0	0	0	0	0	0

**Conditions** contain information about which conditions were used in the randomization, marked with yes, and not used marked with no. In the Errors column is a record of how many times in the crop sequence each conditions were not met.

dataset name	Conditions	Errors
NoWinterRapeAfterWinterWheat	Yes	0
NoWinterRapeAfterSpringWheat	Yes	0
NoWinterRapeAfterWinterRye	Yes	0
NoWinterRapeAfterWinterRape	Yes	0
NoWinterRapeAfterSpringRape	Yes	0
NoSpringRapeAfterWinterRape	Yes	0
NoSpringRapeAfterSpringRape	Yes	0
NoLeyAfterPotatoes	Yes	0
NoSugarbeetsAfterPotatoes	Yes	0
NoPotatoesAfterPotatoes	Yes	0
NoWinterRapeAfterPotatoes	Yes	0
NoLeyAfterSugarbeets	Yes	0
NoAutumnSownCropsAfterSugarbeets	Yes	0
NoGreenManureAfterGreenManure	No	0
NoFertilizedCropsAfterGreenManure	No	0
NoGreenManureAfterLey	No	0
NoLeyAfterGreenManure	No	0
NoAutumnSownCropsAfterAutumnSownCrops	No	0
NotMoreThan2YearsOfCerealsInARow	No	0
NoLeyAfterLey	No	0
SpringPlowing	Yes	6
SpringPlowingLey	Yes	1
SpringPlowingFallow	Yes	0
SpringplowingGreenmanure	Yes	0
AutumnBeans	No	0
LeyGreenMBeansPeas	No	0
NFixGreenM	No	0
NFixLey	No	0
FallowFallow	No	0
NoFertilizedCropsAfterLey	No	0
NFixNFix	No	0
ExtraCondition1	No	0
ExtraCondition1Crop1		
ExtraCondition1Crop2		
ExtraCondition2	No	0
ExtraCondition2Crop1		
ExtraCondition2Crop2		
ExtraCondition3	No	0
ExtraCondition3Crop1		
ExtraCondition3Crop2		
ExtraCondition4	No	0
ExtraCondition4Crop1		
ExtraCondition4Crop2		
ExtraCondition5	No	0
ExtraCondition5Crop1		
ExtraCondition5Crop2		
ExtraCondition6	No	0
ExtraCondition6Crop1		
ExtraCondition6Crop2		
ExtraCondition7	No	0
ExtraCondition7Crop1		
ExtraCondition7Crop2		

dataset name	Conditions	Errors
ExtraCondition8	No	0
ExtraCondition8Crop1		
ExtraCondition8Crop2		
ExtraCondition9	No	0
ExtraCondition9Crop1		
ExtraCondition9Crop2		
ExtraCondition10	No	0
ExtraCondition10Crop1		
ExtraCondition10Crop2		
ExtraCondition11	No	0
ExtraCondition11Crop1		
ExtraCondition11Crop2		
ExtraCondition12	No	0
ExtraCondition12Crop1		
ExtraCondition12Crop2		
LeyLasts	3 years	3 years
LeyScatter	±0 %	±0 %
LeyFromDB	No	No
MaxLeyLength	5	5

**Inställningar** contains some metadata for the randomization.

Klimat is the climate used.

Region is the region.

StartÅr is the first year in the crop sequence.

Längd is the number of years in the dataset.

Antal dataset is the total number of dataset. So in this example the total number of years in the crop sequence is  $10000 = 20 * 500$ .

Klimat	Region	StartÅr	Längd	Antal dataset	
01a - Skåne-Hallands slättbygd	Skånedelen	po01a	1971	20	500

**Slump** is the table containing the crop sequence and all randomized information.

NUMMER Position in the crop sequence.

GRÖDA Crop in Swedish.

GÖDSELTYP Manure (stallgödsel) or fertilizer (handelsgödsel).

HÖSTVÅRSPRIDNING Autumn (höstspredning) or spring (vårspridning) spreading of manure.

VALLNR The leys are numbered in blocks to allow them to be moved in units during the randomization.

STRAW\_INCORP Incorporation of plant residuals.

FÅNGGRÖD\* Catch crop 100 = Spring cultivated catch crop, 200 = autumn cultivated catch crop, 300 = Spring cultivation.

FÅNGGRÖDMOD\* Catch crop 100 = Spring cultivated catch crop, 200 = autumn cultivated catch crop, 300 = Spring cultivation. A new randomization has to be used as the proportions between the different catch crops is different when a correction for spring cultivation on clay soils has been made.

PLÖJNINGFÅNGGRÖDA<sup>+</sup> HP = autumn plowing, VP = spring plowing, FHP = catchcrop autumn plowing, FVP = catchcrop springplowing

\* For Soilndb 2.x

<sup>+</sup> For Soilndb 3.x

NUMMER	GRÖDA	GÖDSELTYP	HÖSTVÅR SPRIDNING	VALLNR	STRAW_ INCORP	FÅNG GRÖD	FÅNGGRÖD MOD	PLÖJNING FÅNGGRÖDA
1	WINTER_WHEAT	Handelsgödsel	Vårspridning		No	0	0	HP
2	WINTER_WHEAT	Handelsgödsel	Vårspridning		No	0	0	FHP
3	SPRING_BARLEY	Handelsgödsel	Vårspridning		No	0	0	HP
4	LEY	Stallgödsel	Vårspridning	3001	Yes	0	0	HP
5	LEY	Stallgödsel	Vårspridning	3002	Yes	0	0	HP
6	LEY	Handelsgödsel	Vårspridning	3003	Yes	0	0	HP
7	WINTER_WHEAT	Handelsgödsel	Vårspridning		Yes	0	0	HP
8	POTATOES	Handelsgödsel	Vårspridning		Yes	0	0	HP
9	WINTER_WHEAT	Stallgödsel	Höstspredning		Yes	0	0	HP
10	WINTER_WHEAT	Handelsgödsel	Vårspridning		No	0	0	FVP
11	SPRING_BARLEY	Handelsgödsel	Vårspridning		Yes	0	0	HP
12	WINTER_RAPE	Handelsgödsel	Höstspredning		Yes	0	0	HP

## SOILNDB 2.x input database

**Catchcrop** contains information about the number of actual catch crop occurrences in the crop sequence and the potential maximal number.

<i>Crop</i>	<i>Pot_Catchcrop</i>	<i>Act_Catchcrop</i>
havre	324	157
höstkorn	117	73
höstraps	202	0
höstvete	1270	591
potatis	144	0
råg	90	67
sockerbetor	1329	0
träda	447	0
vall	254	0
vårkorn	1380	651
vårrops	119	16
vårvete	304	209

**Cropping system** (part 1) This is the table that contains the agricultural information.

**ID\_no** The number of the dataset, a dataset contains up to 20 years.

**Year** Simulation year, the climate is used for this year.

**Manure\_type\_1** The type of manure applied, always Slurry, cattle.

**Manure\_amount\_1** The amount of manure, not used, set to 1 to activate the proper functions in SOILNDB.

**Ammonium\_cont\_1** Amount of NH<sub>4</sub> (kg/ha).

**Org\_N\_cont\_1** Amount of organically bound nitrogen (kg/ha).

**C-N\_ratio\_1** The ratio of C to N in the manure.

**Manure\_time\_1** Spreading date.

**Manure\_spread\_1** Type of spreading used, always Broadc. spr.

**Manure\_inc\_1** Whether or not the manure is incorporated after spreading.

ID_no	Year	Manure_ type_1	Manure_ amount_1	Ammonium_ cont_1	Org_N_ cont_1	C-N_ ratio_1	Manure_ time_1	Manure_ spread_1	Manure_ inc_1
2	1988								
2	1989								
2	1990	Slurry, cattle	1	38	39	20	19900330	Broadc. spr.	Nej
2	1991	Slurry, cattle	1	38	39	20	19910330	Broadc. spr.	Nej
2	1992								
3	1973								
3	1974								
3	1975								
3	1976								

The fields Manure\_type\_1 to Applic\_loss\_1 are repeated 3 times, Manure\_type\_2 to Applic\_loss\_2, Manure\_type\_3 to Applic\_loss\_3, allowing spreading of manure at 3 times per season. Only one spreading is used.

**Cropping system (part 2)**

*Time\_inc\_1* Hours between spreading and incorporation. Zero or one hour.

*Ley\_1* Whether or not the manure was spread on a ley.

*Applic\_loss\_1* Losses during application of manure, set to 0 as the loss from applied amount of N is already calculated in the application amount.

*Fert\_1* Amount of fertilizer (kg/ha).

*Fert\_time\_1* Date of fertilizer spreading.

*Fert\_x* and *Fert\_time\_x* are repeated 4 times, allowing 4 spreading of fertilizer per year, x is 1 to 4. Only one spreading is used when the table is constructed by CSMG.

*Crop* The crop.

*Sowing\_timep* Sowing date.

<i>Time_inc_1</i>	<i>Ley_1</i>	<i>Applic_loss_1</i>	<i>Fert_1</i>	<i>Fert_time_1</i>	...	<i>Fert_time_4</i>	<i>Crop</i>	<i>Sowing_timep</i>
			99	19880414	...		Spring barley	19880415
			0		...		Fallow	
0	Yes	0	184	19900331	...		Ley	
0	Yes	0	184	19910331	...		Ley	
			181	19920330	...		Ley	
			113	19730419	...		Sugar beets	19730420
			113	19740419	...		Sugar beets	19740420
			113	19750419	...		Sugar beets	19750420
			99	19760414	...		Spring barley	19760415
			84	19770331	...		Winter barley	19760922

**Cropping system (part 2)**

*Harvest\_1\_yield* The yield of the first harvest (kg/ha).

*Harvest\_1\_time* The date of the first harvest.

*Harvest\_2\_yield* The yield of the second harvest (kg/ha) only used for ley.

*Harvest\_2\_time* The date of the second harvest only used for ley.

*Inc\_Straw&tops* Whether or not crop residuals are incorporated in the soil (yes) or removed from the field (no).

*Soil\_cultiv* Whether or not the soil is cultivated.

*Soil\_cultiv\_time* The date of the soil cultivation.

*C\_upa2* The uptake of the catch crop in the autumn (kg/ha).

*Grain\_N\_content* The percentage of N in the harvested crop.

*Remarks* Commentaries.

<i>Harvest_1_yield</i>	<i>Harvest_1_time</i>	<i>Harvest_2_yield</i>	<i>Harvest_2_time</i>	<i>Inc_straw &amp; tops</i>	<i>Soil_cultiv</i>	<i>Soil_cultiv_time</i>	<i>c_upa2</i>	<i>grain_N_content</i>	<i>remarks</i>
5695.8	19880819	0		no	Yes	19881015		1.7	
0		0		Yes	Yes	19891201			
6521.5	19900615	3260.7	19900815	Yes	No			2	
6521.5	19910615	3260.7	19910815	Yes	No			2	
6521.5	19920615	3260.7	19920815	Yes	Yes	19921015		2	
51972.8	19731101	0		Yes	Yes	19731108		0.2	
51972.8	19741101	0		Yes	Yes	19741108		0.2	
51972.8	19751101	0		Yes	Yes	19751108		0.2	
5695.8	19760819	0		Yes	Yes	19760822		1.7	
5613.3	19770820	0		no	Yes	19771015		1.7	

**Deposition** is the amount of atmospheric deposition of nitrogen.

**ID\_no** Reference to the dataset number in “Cropping system” table.

**County** If no data is given for the deposition then data from county are used. “Skåne” is used for all of Sweden as this parameter is not used but must have some content.

**Inorg\_N** Nitrogen deposited with precipitation (mg/l).

**Dry\_dep** Dry deposited nitrogen (kg/ha).

ID_no	County	Inorg_N	Dry_dep
1	Skåne	1.32	3
2	Skåne	1.32	3
3	Skåne	1.32	3
4	Skåne	1.32	3
5	Skåne	1.32	3

**Extra** The table Extra is used to save data about the database, in order to easily determine what data the database is created from.

The Region field is also used when the crop sequence is read from a SOILNDB database.

**Date** The day the database was created

**Name** The name of the person who created the database, can also be used as a commentary field for the database.

**Climate file** Filename and path of the climate database file used to create the database.

**Indata** Filename and path of the input database file used to create the database.

**Region** The region the database was created for.

Date	Name	Climate file	Indata	Region
2007-08-07	KP	C:\SoilNDB\database\Climate.mdb	C:\NLeCCS\indata.xls	po1a

**Hydrology** contains the hydrological settings for the simulation. DDIST, DDRAIN and GFLOW1 is only used if drainage is simulated, that is GWFLOW is set to -1.

**ID\_no** The dataset number.

**DDIST** Distance between drainage pipes (m).

**DDRAIN** Depth of drainage pipes (m).

**GFLOW1** Amount of water that bypasses the drainage pipes to the ground water (mm/day).

**LAYERS** Number of computational layers, 5 or 6.

**GWFLOW** Switch between free drainage (0) and drainage pipes (-1).

ID_no	DDIST	DDRAIN	GFLOW1	LAYERS	GWFLOW
1	10	0.9	0	5	0
2	10	0.9	0	5	0
3	10	0.9	0	5	0
4	10	0.9	0	5	0
5	10	0.9	0	5	0

**ID number** is table that contains the link between the dataset name and the column ID\_no used in the other tables.

**ID\_no** The dataset number.

**Dataset name** The name of the dataset, generally constructed from the climate name and the region name and the ID\_no.

**Climate file** Name of the climate table in the climate file.

**Area** The size of the field, not used.

**Comments** Comments.

ID_no	dataset name	climate file	Area	comments
1	1a Skåne-Hallands slättbygd Skånedelen po1a 00001	1a Skåne-Hallands slättbygd Skånedelen		
2	1a Skåne-Hallands slättbygd Skånedelen po1a 00002	1a Skåne-Hallands slättbygd Skånedelen		
3	1a Skåne-Hallands slättbygd Skånedelen po1a 00003	1a Skåne-Hallands slättbygd Skånedelen		
4	1a Skåne-Hallands slättbygd Skånedelen po1a 00004	1a Skåne-Hallands slättbygd Skånedelen		
5	1a Skåne-Hallands slättbygd Skånedelen po1a 00005	1a Skåne-Hallands slättbygd Skånedelen		
6	1a Skåne-Hallands slättbygd Skånedelen po1a 00006	1a Skåne-Hallands slättbygd Skånedelen		

**Soil data** Information about soil data for each dataset.

**ID\_no** The dataset number.

**Soil name.**

**Topsoil** The soil in the upper layer.

**Subsoil** The soil in the lower layer.

**Sub\_SOM\_Content** Organic matter in subsoil.

**Top\_SOM\_Content** Organic matter in topsoil.

ID_no	Soil name	topsoil	subsoil	sub_SOM_Content	top_SOM_Content
1	Standard	Silty clay	Silty clay	0.1	4.3
2	Standard	Silty clay	Silty clay	0.1	4.3
3	Standard	Silty clay	Silty clay	0.1	4.3
4	Standard	Silty clay	Silty clay	0.1	4.3
5	Standard	Silty clay	Silty clay	0.1	4.3
6	Standard	Silty clay	Silty clay	0.1	4.3
7	Standard	Silty clay	Silty clay	0.1	4.3
8	Standard	Silty clay	Silty clay	0.1	4.3
9	Standard	Silty clay	Silty clay	0.1	4.3
10	Standard	Silty clay	Silty clay	0.1	4.3

### **SOILNDB 3.x input database**

The SOILNDB 3.x input database contains 9 tables.

*Catchcrop* is not used. It is a relic from SOILNDB 2.x.

*Conditions* this is the exact same table as is saved in the crop sequence database. It is saved here to help the user to know the database was generated.

*Cropping system* (part 1) This is the main table which contains all the information about the agriculture.

*Nr* The row number used for sorting the data.

*Year* The year the crop is grown.

*Crop* The main crop.

*PostCrop* The postcrop or if the main crop has several harvest the harvest number.

*Harvest* Harvest, at standard water content defined in the SOILNDB parameter database (kg/ha).

*Grain N Content* N content in harvest product. Can be left empty, default values is taken from the parameter database (% dm).

*Residues N Content* N content in harvest residues. Can be left empty, default values is taken from the parameter database (% dm).

*Removal* Percentage of the entered harvest that is removed from the field (%).

*Remove Harvest residues* "Yes" if harvest residues is removed from the field otherwise "No".

ID_no	Nr	Year	Crop	Post Crop	Harvest	Grain N Content	Residues N Content	Removal	Remove Harvest residues
1	0	1971	Winter rape	1	3344	3.3	1.43	100	No
1	1	1972	Oats	1	4643.1	2.1	1	100	No
1	2	1973	Sugar beets	1	52812.1	0.8	2.25	100	No
1	3	1974	Spring wheat	1	5431.8	2.4	1	100	No
1	4	1975	Winter wheat	1	8039.9	2.2	1	100	Yes
1	5	1976	Spring barley	1	5308.6	2	1	100	No
1	6	1977	Fallow, stubble	1		2	2	30	No
1	7	1978	Winter wheat	1	8039.9	2.2	1	100	Yes
1	8	1979	Winter rye	1	5066.6	2	1	100	No
1	9	1980	Winter wheat	1	8039.9	2.2	1	100	No
1	10	1981	Sugar beets	1	52812.1	0.8	2.25	100	No

**Cropping system** (part 2). Sowing, harvest and soil management dates.

*Sowing date* Date the crop is sown (date).

*Harvest date* Date the crop is harvested (date).

*Stubbel date* Date the soil is stubbled (date).

*Stubbel eff* The weed killing efficiency of the stubbling (%).

*Plowing date* Date the soil is plowed (date).

Sowing date	Harvest date	Stubbel date	Stubbel eff	Plowing date
1970-08-23	1971-08-05	1971-08-15	25	1971-10-09
1972-04-08	1972-08-19			1972-10-09
1973-04-13	1973-11-01			1973-11-02
1974-04-22	1974-09-04			1974-09-15
1974-09-22	1975-09-01			1975-10-09
1976-04-08	1976-08-19			1976-10-09
				1977-07-25
1977-09-22	1978-09-01			1978-09-15
1978-09-22	1979-08-20			1979-09-15
1979-09-22	1980-09-01			1980-10-09
1981-04-13	1981-11-01			1981-11-02

**Cropping system** (part 3) fertilization and nitrogen fixation.

*Fertilization date 1* Date for fertilization date

*Fertilization NO3 1* Amount of NO3 in chemical fertilizer (kg/ha).

*Fertilization NH4 1* Amount of NH4 in chemical fertilizer (kg/ha).

*N-fixation NH4 1* Amount of NH4 fixated by the crop (kg/ha).

*Fertilization date 2* Date for second fertilization date.

*Fertilization NO3 2* Amount of NO3 in chemical fertilizer (kg/ha).

*Fertilization NH4 2* Amount of NH4 in chemical fertilizer (kg/ha).

*N-fixation NH4 2* Amount of NH4 fixated by the crop (kg/ha).

Fertilization date 1	Fertilization NO3 1	Fertilization NH4 1	N-fixation NH4 1	Fertilization date 2	Fertilization NO3 2	Fertilization NH4 2	N-fixation NH4 2
1971-03-28	160						
1972-04-07	91						
1973-04-12	123						
1974-04-21	119						
1975-03-28	120						
1976-04-07	63						
1978-03-28	120						
1979-03-28	88						
1980-03-27	149						
1981-04-12	98						

**Cropping system** (part 4) application of manure.

**Manure date** Date manure is applied (date).

**Manure amount** Amount of manure (ton).

**Manure type\*** Origin (cattle, pig & hen) and type of manure (slurry, urine & solid). Manure

**NH4** Percentage of NH4 in manure (%).

**Manure OrgN** Percentage of NO3 in manure (%).

**Manure CN Ration** between carbon and nitrogen in manure (-).

**Manure spreading\*** Type of spreading (band spreading, broadcast spreading).

**Manure incorp\*** "Yes" Manure is incorporated in the soil, "No" it is not incorporated.

**Manure time incorp\*** Time till incorporation. (hours).

**Ley\*** Yes if the crop is a ley otherwise no.

**Manure application loss** The loss of nitrogen through volatilization (%).

\*Information fields, do not affect the simulation.

Manure date	Manure amount	Manure type	Manure NH4	Manure OrgN	Manure CN	Manure spreading	Manure incorp	Manure time incorp	Ley	Manure application loss
1975-03-27	1	Slurry, cattle	31	35	20	Broadc. spr.	Nej	0	No	0
1976-04-06	1	Slurry, cattle	40	47	20	Broadc. spr.	Ja	1	No	0
1977-09-20	1	Slurry, cattle	31	35	20	Broadc. spr.	Ja	1	No	0
1981-04-11	1	Slurry, cattle	39	59	20	Broadc. spr.	Ja	1	No	0

**Deposition** is the amount of atmospheric deposition of nitrogen.

**ID\_no** Reference to the dataset number in "Cropping system" table.

**County** If no data is given for the deposition then data from county are used. "Skåne" is used for all of Sweden as this parameter is not used but must have some content.

**Inorg\_N** Nitrogen deposited with precipitation (mg/l).

**Dry\_dep** Dry deposited nitrogen (kg/ha).

ID_no	County	Inorg_N	Dry_dep
1	Skåne	1.32	3
2	Skåne	1.32	3
3	Skåne	1.32	3
4	Skåne	1.32	3
5	Skåne	1.32	3

**Extra** The table Extra is used to save data about the database, in order to easily determine what data the database is created from.

The Region field is also used when the crop sequence is read from a SOILNDB database.

**Date** The day the database was created

**Name** The name of the person who created the database, can also be used as a commentary field for the database.

**Climate file** Filename and path of the climate database file used to create the database.

**Indata** Filename and path of the input database file used to create the database.

**Region** The region the database was created for.

Date	Name	Climate file	Indata	Region
2007-08-07	KP	C:\NLeCCS\Climate.mdb	C:\NLeCCS\indata.xls	po1a

**Hydrology** contains the hydrological settings for the simulation. DDIST, DDRAIN and GFLOW1 is only used if drainage is simulated, that is GWFLOW is set to -1.

**ID\_no** The dataset number.

**DDIST** Distance between drainage pipes (m).

**DDRAIN** Depth of drainage pipes (m).

**GFLOW1** Amount of water that bypasses the drainage pipes to the ground water (mm/day).

**LAYERS** Number of computational layers, 5 or 6.

**GWFLOW** Switch between free drainage (0) and drainage pipes (-1).

ID_no	DDIST	DDRAIN	GFLOW1	LAYERS	GWFLOW
1	10	0.9	0	5	0
2	10	0.9	0	5	0
3	10	0.9	0	5	0
4	10	0.9	0	5	0
5	10	0.9	0	5	0

**ID number** is table that contains the link between the dataset name and the column ID\_no used in the other tables.

**ID\_no** The dataset number.

**Dataset name** The name of the dataset, generally constructed from the climate name and the region name and the ID\_no.

**Climate file** Name of the climate table in the climate database.

**Comments** Comments.

**Area** The size of the field, not used.

**Use premade climatefile** If this switch is set to yes then SOILNDB do not generate a climate file from the climate database. Instead a pre made climate file together with the CNUMD, preca0 and preca1 values supplied in this table.

**CNUMD** Description of how many columns is in the climate file, se the SOIL manual.

**Preac0** rain correction factor.

**Preca1** addition to the preca0 correction factor when precipitation falls as snow.

**Local inifile** not used.

**Global inifile** use the same initial settings file for all dataset, generated from information in SOILNDB's parameter database.

**Premade inifile** use a pre made initial settings file supplied by the user.

ID_no	dataset name	climate file	comments	Area	Use premade climatefile	CNUMD	preca0	preca1	Local inifile	Global inifile	Premade inifile
1	1a_sandy_loam 00001	1a		0	nej	0	0	0		1	
2	1a_sandy_loam 00002	1a		0	nej	0	0	0		1	
3	1a_sandy_loam 00003	1a		0	nej	0	0	0		1	
4	1a_sandy_loam 00004	1a		0	nej	0	0	0		1	
5	1a_sandy_loam 00005	1a		0	nej	0	0	0		1	
6	1a_sandy_loam 00006	1a		0	nej	0	0	0		1	

**Soil data** Information about soil data for each dataset.

**ID\_no** The dataset number.

**Soil name.**

**Topsoil** The soil in the upper layer.

**Subsoil** The soil in the lower layer.

**Sub\_SOM\_Content** Organic matter in subsoil.

**Top\_SOM\_Content** Organic matter in topsoil.

ID_no	Soil name	topsoil	subsoil	sub_SOM_Content	top_SOM_Content
1	Standard	Silty clay	Silty clay	0.1	4.3
2	Standard	Silty clay	Silty clay	0.1	4.3
3	Standard	Silty clay	Silty clay	0.1	4.3
4	Standard	Silty clay	Silty clay	0.1	4.3
5	Standard	Silty clay	Silty clay	0.1	4.3
6	Standard	Silty clay	Silty clay	0.1	4.3
7	Standard	Silty clay	Silty clay	0.1	4.3
8	Standard	Silty clay	Silty clay	0.1	4.3
9	Standard	Silty clay	Silty clay	0.1	4.3
10	Standard	Silty clay	Silty clay	0.1	4.3

**Version** The version of SOILNDB that can use the database.

Version

3.0.x

### ***Minimum requirements***

The Crop Sequence and Management Generator is written in MS Visual Basic.NET 2003.

Minimum requirements are Windows 2000, Windows XP.

Microsoft Office 2003 is also needed.

## **Crop average MS Excel Macro**

A MS Excel macro is used for generating averages for selected variables for each crop and soil combination. The macro opens a MS Access result database from SOILNDB and extracts all occurrences of each crop in turn. Then an average is made for the variables in that selection. Each SOILNDB result database contains data from simulation of one soil only, so the process is repeated for all soils.

## Completer 1.0.6

The completer generates a complete leaching coefficients array with values for all crops. Crops with a smaller area than 1 % of the total area in a region are not simulated in that region. In order to generate the complete result array, some values has to be substituted with other crops or averages of other crops. The completer uses a two step approach, were the secondary substitution is used if the primary is not available in the region. The substitution averages is calculated by ICECREAMDB during the simulations and saved in the same result files. The indata files is the normal MS Excel result files from ICECREAMDB or the MS Excel macro for nitrogen.

The completer also takes background values that are normally only calculated for one soil phosphorus class and extends them to all classes.

The completer also saves the result in format specified by SMHI (Swedish Meteorological Hydrological Institute) and TPS. The SMHI and TPS only contains particulate phosphorus and solute phosphorus respectively total phosphorus. The SLU format can take any number of variables specified in the settings database.

### ***The settings database***

A MS Access database governs the completer, the settings database.

Tables used for phosphorus and nitrogen completion in the settings database.

Table	Phosphorus	Nitrogen
Crops	x	x
Excel_Sheetnames	x	
FertMan	x	
FormatString	x	x
Metadata	x	x
P Column names	x	
P Column names 2	x	
Slopes	x	
SoilP	x	
Soils	x	x
Substance	x	x

**Crops** a table that contains the crop names and the substitution crops / crop averages. Crop is the name in NLeCCS, TPS is the TPS system name and SMHI is the SMHI name. Subst\_1 is the primary substitution crop and Subst\_2 is the secondary. Nr is an order field.

Crop	TPS	SMHI	Subst_1	Subst_2	Nr
s_barley	Vårkorn	vårkorn	spr	X	01
w_wheat	Höstvete	höstvete	fall	X	02
ley	Vall	vall	fallow_gr	All	03
su_beet	Socketbetor	socketbetor	spr	X	04
w_rape	Höstraps	höstraps	fall	X	05
fallow	Grönträda	träda	All	All	06
oats	Havre	havre	spr	X	07
s_wheat	Vårvete	vårvete	spr	X	08
w_rye	Råg	råg	fall	X	09
s_rape	Vårraps	vårraps	spr	X	10
potato	Potatis	potatis	spr	X	11
Medel_excl	Smågrödor	Medel exkl.	X	X	12
höstkorn	Höstkorn	höstkorn	fall	X	15
undef_arable	Odefgrödor	bakgrund	Bakgrund	X	16
pasture	ExtensivVall	betesmark	fallow_gr	X	17

**Excel\_Sheetnames** contains the sheet names in the Excel result workbook that contains the crop leaching (Grödvärden) and the crop averages (Medelvärden) of leaching for the substitution.

Grödvärden	Medelvärden
Yearly sums_Crop	Yearly sums_AVG_Crop

**FertMan** contains the abbreviations for crops that receive chemical fertilizer (FERT) and manure (MANURE) in TPS and SMHI files.

Classes	TPS	SMHI
FERT	F	'F'
MANURE	M	'F+M'

**FormatString** contains the format witch is used to regulate the number of decimals in the result files.

FormatString
#0.00000

**Metadata** contains the name of the regions in the NLeCCS, SMHI and TPS systems.

Region	TPS	SMHI
Eman_H0	Eman_Hctrl	Eman_Hctrl
Eman_HA2	Eman_HA2	Eman_HA2
Eman_HB2	Eman_HB2	Eman_HB2

**P Column names** contains the column names for the Total phosphorus (TOTP), solute Phosphorus (PO4P) and particle bound phosphorus (PP) is in the Excel result files.

TOTP	PO4P	PP
TotP_red_YC (mg/l)	SRP_red_YC (mg/l)	PP_red_YC (mg/l)

**P Column names 2** contains the column names for all variables that should be included in the SLU completion. The Nr column set the order of the variables in the outfile.

Column name	Nr
PP_red_YC (mg/l)	01
SRP_red_YC (mg/l)	02
TotP_red_YC (mg/l)	03
Allwater (l/ha)	04
dayrun (mm)	05
sedp (kg/ha)	06
rolp (kg/ha)	07
DrainPP (kg/ha)	08
Pleach (kg/ha)	09

**Slopes** contains the names of the slope classes in NLeCCS (Classes) and TPS and SMHI. Nr is an order field.

Classes	TPS	SMHI	Nr
Low	1	1	01
Medium	2	2	02
Steep	3	3	03

**SoilP** contains the names of the Soil phosphorus classes in NLeCCS (Classes) and TPS and SMHI. Nr is an order field.

Classes	TPS	SMHI	Nr
Low	1	1	01
Medium	2	2	02
High	3	3	03

**Soils** contains the names of the Soil classes in NLeCCS (Classes) and TPS and SMHI. Nr is an order field.

Classes	TPS	SMHI	Nr
S01F-Sand	Sand	Sand	01
S02F-LoamySand	LoamySand	LoamySand	02
S03F-SandyLoam	SandyLoam	SandyLoam	03
S04F-Loam	Loam	Loam	04
S05F-SiltyLoam	SiltLoam	SiltLoam	05
S06F-SandyClayLoam	SandyClayLoam	SandyClayLoam	06
S07F-ClayLoam	ClayLoam	ClayLoam	07
S08F-SiltyClayLoam	SiltyClayLoam	SiltyClayLoam	08
S09F-SiltyClay	SiltyClay	SiltyClay	09
S10F-Clay	Clay	Clay	10

**Substance** is the substance, N or P, that is to be completed.

Substance
P

## TPS file format

The TPS file is a semicolon delimited text file. One file per region. It is designed for import into a database system. All fields is not relevant for leaching of nutrients from agricultural land.

```
Filformat;TPS_GENERIC_VA;;;;;;;;;;
Submission;TRK;;;;;;;;;;
Antal kolumner;14;;;;;;;;;;
Filidentifierare;NormUtlKoeffP;;;;;;;;;;
Antal rader;8100;;;;;;;;;;
Första rad med data;15;;;;;;;;;;
Rubrikrad för tabell;14;Områdestyp;Utlakningsregion;;;;;;;;;;
Operationslista;Dataimport;;;;;;;;;;
;;;;;;;;;;
;;;;;;;;;;
;;;;;;;;;;
;;;;;;;;;;
Emissionyear;Region;D1;D2;D3;D4;D5;D6;D7;D8;D9;;Unit;;
År;Område;Tid;Substans;Begrepp;Inland;Källtyp;Jordart;GödselK;FosforK;LutnK;Värde;Enhet;Kommentar;
NA;Utlakningsregion\Eman_Hctrl;År;P;NormUtlKoeff;NA;Vårkorn;Sand;F;1;1;0.02978;mg/l;;
NA;Utlakningsregion\Eman_Hctrl;År;P;NormUtlKoeff;NA;Vårkorn;Sand;F;2;1;0.03680;mg/l;;
NA;Utlakningsregion\Eman_Hctrl;År;P;NormUtlKoeff;NA;Vårkorn;Sand;F;3;1;0.04597;mg/l;;
NA;Utlakningsregion\Eman_Hctrl;År;P;NormUtlKoeff;NA;Sockerbetor;Sand;F;1;1;0.02984;mg/l;Kompletterat värde;
NA;Utlakningsregion\Eman_Hctrl;År;P;NormUtlKoeff;NA;Sockerbetor;Sand;F;2;1;0.03687;mg/l;Kompletterat värde;
NA;Utlakningsregion\Eman_Hctrl;År;P;NormUtlKoeff;NA;Sockerbetor;Sand;F;3;1;0.04605;mg/l;Kompletterat värde;
```

## The SMHI P and SLU P file format

The SMHI file is a MS Excel workbook, with one sheet per region.

!!'Klass is the class composed of crop and soil name.

Region is the region.

P-HCIklass is the soil phosphorus class.

Lutningsklass is the soil slope class.

Gödselform is the fertilization type, chemical fertilization or manure application.

PP(mg/l) is the concentration of particle bound phosphorus.

PO4-P(mg/l) is the concentration of solute phosphorus.

!!' Klass	Region	P-HCIklass	Lutningsklass	Gödselform	PP(mg/l)	PO4-P(mg/l)
'vårkorn Sand'	Eman_HB2	1	1	'F'	0.00219	0.02497
'vårkorn Sand'	Eman_HB2	2	1	'F'	0.00254	0.03112
'vårkorn Sand'	Eman_HB2	3	1	'F'	0.00301	0.03916
'vårkorn Sand'	Eman_HB2	1	2	'F'	0.0046	0.02513
'vårkorn Sand'	Eman_HB2	2	2	'F'	0.00535	0.03132
'vårkorn Sand'	Eman_HB2	3	2	'F'	0.00633	0.03941
'vårkorn Sand'	Eman_HB2	1	3	'F'	0.00898	0.0254
'vårkorn Sand'	Eman_HB2	2	3	'F'	0.01044	0.03165
'vårkorn Sand'	Eman_HB2	3	3	'F'	0.01235	0.03982
'vårkorn Sand'	Eman_HB2	1	1	'F+M'	0.00219	0.02497
'vårkorn Sand'	Eman_HB2	2	1	'F+M'	0.00254	0.03112
'vårkorn Sand'	Eman_HB2	3	1	'F+M'	0.00301	0.03916
'vårkorn Sand'	Eman_HB2	1	2	'F+M'	0.0046	0.02513
'vårkorn Sand'	Eman_HB2	2	2	'F+M'	0.00535	0.03132
'vårkorn Sand'	Eman_HB2	3	2	'F+M'	0.00633	0.03941
'vårkorn Sand'	Eman_HB2	1	3	'F+M'	0.00898	0.0254
'vårkorn Sand'	Eman_HB2	2	3	'F+M'	0.01044	0.03165
'vårkorn Sand'	Eman_HB2	3	3	'F+M'	0.01235	0.03982

The SLU format is the same but can contain any number of variables.

!!' Klass	Region	P-HCI klass	Lutnings klass	Gödselform	PP_red_ YC (mg/l)	SRP_red_ YC (mg/l)	TotP_red_ YC (mg/l)	Allwater r (l/ha)	dayrun (mm)
'vårkorn Sand'	Eman_HB2	1	1	'F'	0.002188	0.024966	0.028991	371118	9.01418
'vårkorn Sand'	Eman_HB2	2	1	'F'	0.002545	0.031117	0.0358	371118	9.01418
'vårkorn Sand'	Eman_HB2	3	1	'F'	0.00301	0.039159	0.0447	371118	9.01418
'vårkorn Sand'	Eman_HB2	1	2	'F'	0.004601	0.02513	0.032951	371124	9.61733
'vårkorn Sand'	Eman_HB2							0	

## The SMHI N file format

The SMHI file is a MS Excel workbook, with one sheet per region.

The N-coefficient matrix is much simpler and contains of crop (Gröda) and soil classes.

Gröda	Sand	Loamy sand	Sandy loam	Loam	Silt loam	Sandy clay loam	Clay loam	Silty clay loam	Silty clay	Clay
Spring barley	11.4	9.9	9.3	8.9	8.9	7.9	7.1	6.6	5.3	4.2
Winter wheat	9.2	7.4	6.8	6.1	6.1	4.6	3.8	3.4	2.6	2.2
Ley, >25% Clov	5.6	4.7	3.3	2.7	2.3	2.4	1.7	1.5	1.2	1.1
Sugar beets	7.9	6.8	5.8	5.3	5.1	4.7	4.0	3.6	2.9	2.3
Winter rape	7.9	6.8	5.8	5.3	5.1	4.7	4.0	3.6	2.9	2.3
Ley, Green Manure	8.3	7.8	7.3	6.9	6.5	6.4	5.6	5.2	4.5	2.8
Oats	10.8	9.6	9.2	8.8	8.9	7.8	7.1	6.5	5.2	4.2
Spring wheat	7.9	6.8	5.8	5.3	5.1	4.7	4.0	3.6	2.9	2.3
Winter rye	7.9	6.8	5.8	5.3	5.1	4.7	4.0	3.6	2.9	2.3
Spring rape	13.1	10.6	9.1	8.4	8.1	7.3	6.2	5.7	4.5	4.0
Potatoes	7.9	6.8	5.8	5.3	5.1	4.7	4.0	3.6	2.9	2.3
Winter barley	7.9	6.8	5.8	5.3	5.1	4.7	4.0	3.6	2.9	2.3
Pasture medel	4.6	3.8	2.5	1.9	1.6	1.8	1.2	1.0	0.8	0.8
Supermedel	7.9	6.8	5.8	5.3	5.1	4.7	4.0	3.6	2.9	2.3
Supermedel	11.0	9.5	9.0	8.6	8.6	7.5	6.7	6.2	4.9	4.0

### ***Minimum requirements***

The Completer is written in MS Visual Basic.NET 2003.  
 Minimum requirements are Windows 2000, Windows XP.  
 Microsoft Office 2003 is also needed.

## **Crop Sequence Manipulator 0.0.4**

The CSM is used to change certain properties of a previously generated crop sequence. This is used for analyzing the simulation results. It is possible to check how the type and percentage of catch crops and the proportion of autumn application of manure and spring application affects the nutrient leaching. CSM can change the distribution of catch crops, application times for manure and the ration between crops receiving chemical fertilizer or manure. The modified crop sequence database is used in CSMG to generate simulation databases which are identical to the original except for the selected modified property.

### ***Change catch crop distribution***

The 3 types of catch crops can be redistributed, spring plowed catch crop, autumn plowed catch crop and spring plowing. For each catch crop type the new percentage of it is given and the rest is transformed to a selected catch crop type or ordinary autumn plowing. It is not possible to increase the total catch crop area.

Each catch crop type is extracted from the crop sequence and a proportion is transformed to the selected target. The catch crop positions are then randomized within the extracted catch crop types and written to a new crop sequence database.

### ***Change manure application***

An `indata.xls` is provided and the modified manure application time distribution, and manured area is read from it.

For each crop the new ration between chemical fertilizer and manure is calculated. The new ratio is applied to all crops and the order is randomized within each crop. Then all crops receiving manure are extracted from the crop sequence and the new distribution of application times is applied. The application times are then randomized within each crop.

A new crop sequence database is written.

### ***Minimum requirements***

The Completer is written in MS Visual C#.NET 2005.

Minimum requirements are Windows 2000, Windows XP.

Microsoft Office 2003 is also needed.