Development of Carbon Calculator to promote low carbon farming practices

User guidance manual for the Carbon Calculator

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Joint Research Centre - IES

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1 Introduction

The aim of the Carbon Calculator (CC) is to estimate the greenhouse gas (GHG) emissions from farming practices and to propose climate change mitigation actions at farm level. In that way, this tool contributes to assessing the impact of agriculture on GHG emissions and carbon sequestration. Mitigation actions are evaluated according to their GHG profile, feasibility and cost.

This document presents the general principles to help a novice user understand how to fill in the different modules of the Carbon Calculator.

1.1 Software requirements

The Carbon Calculator can only be run with a PC using Excel 2007 or Excel 2010. Two versions of the Carbon Calculator are available, depending on the Office version used: CC_vXXX_office32bits.xlsm or CC_vXXX_office64bits.xlms. With Excel 2007, the user has to choose the 'office-32 bits' version of the Carbon Calculator. Both versions can be run on Excel 2010.

The Carbon Calculator uses "macros" under Visual Basics for Applications (VBA). Excel settings should be adapted to allow the activation of macros.

1.2 Data collection

The Carbon Calculator assessment is carried out at farm level for a cultivation period of a year. The user defines the beginning and the end of this period based on the production cycle of the farm.

Most of the information needed for the assessment can usually be retrieved in various farm documents: CAP statement, fertilisation plan, farm accounts, invoices, identification of the herd, etc. The user should check the availability of these documents before starting the data collection process. If some documents are missing for the cultivation period targeted, then the user will have to select the previous year.

Depending on existing agricultural production on the farm, the user must select appropriate categories of data. Thus, data collection will be more or less time consuming, depending on the farming system. For example, data requirements are higher for mixed-systems (dairy associated with cereals) than for specialised farms (cereal growers). It is advisable to allow about half a day to one day for data collection.

The assessment is carried out over a year and the required data correspond to the annual inputs used on the farm in relation to the quantity of agricultural products (meat, milk, cereals).

Thus, it is important for the user to check invoices for annual quantities purchased. For example for electricity, invoices are needed to determine the annual consumption of the farm in kWh.

Details of practices for the management of crops and livestock are also needed.

When data about the costs of inputs is provided, the tool can estimate the costs (in euros) of some of the suggested mitigation actions. However, the provision of cost data is optional. If the user is only interested in the carbon footprint of the farm, but not in the costs of the mitigation actions, the provision of financial data is not needed.

Some of the items in the Data list are not related to the farm itself but aim at describing the local environment, for example: dominant type of soil, climate zone, etc. These data are mandatory for the assessment. They will be highlighted when necessary.

1.3 User interface and navigation of the tool

The tool is based on a modular approach. The user is guided step by step through the interface of the Carbon Calculator as illustrated in Figure 1 below (step 1 to step 5).

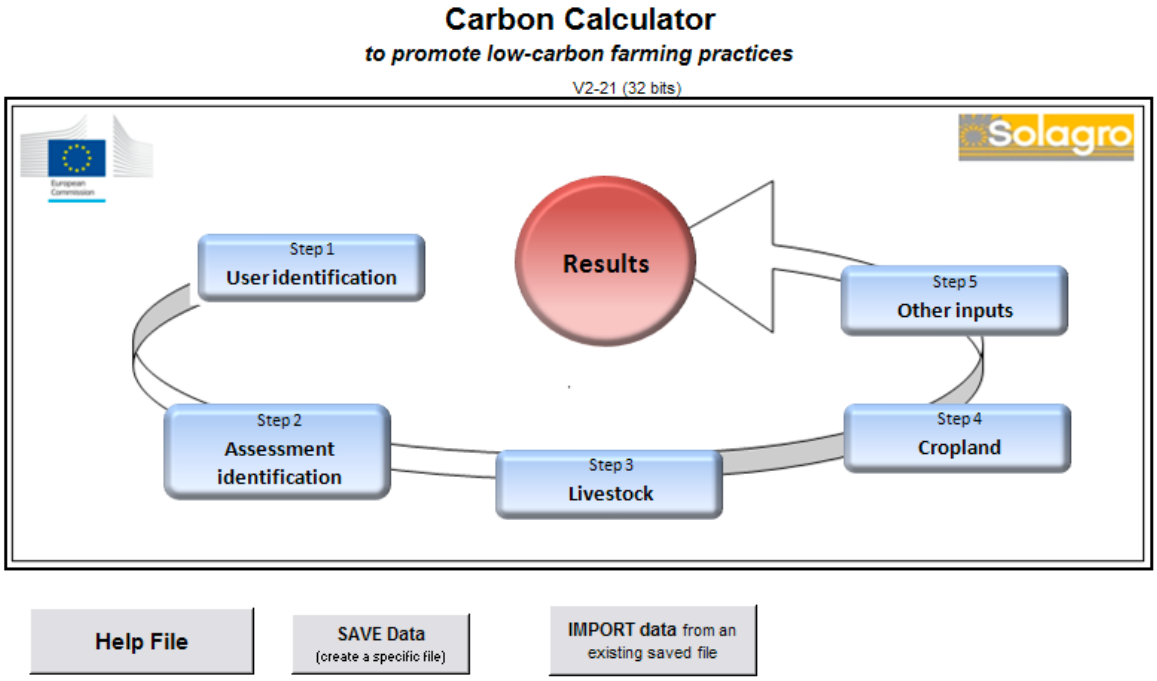


Figure 1: Main menu of the Carbon Calculator

The user is required to start from step 1 “User identification” followed by step 2 “Assessment identification”. Once these modules are filled in, the user has the possibility to go on with either “Livestock”, “Cropland” or “Other inputs”. There is no imposed pathway for data entry in these three modules as illustrated in Figure 2.

From all the screens of the tool, the HOME PAGE button allows the user to come back to the main menu (Figure 1).

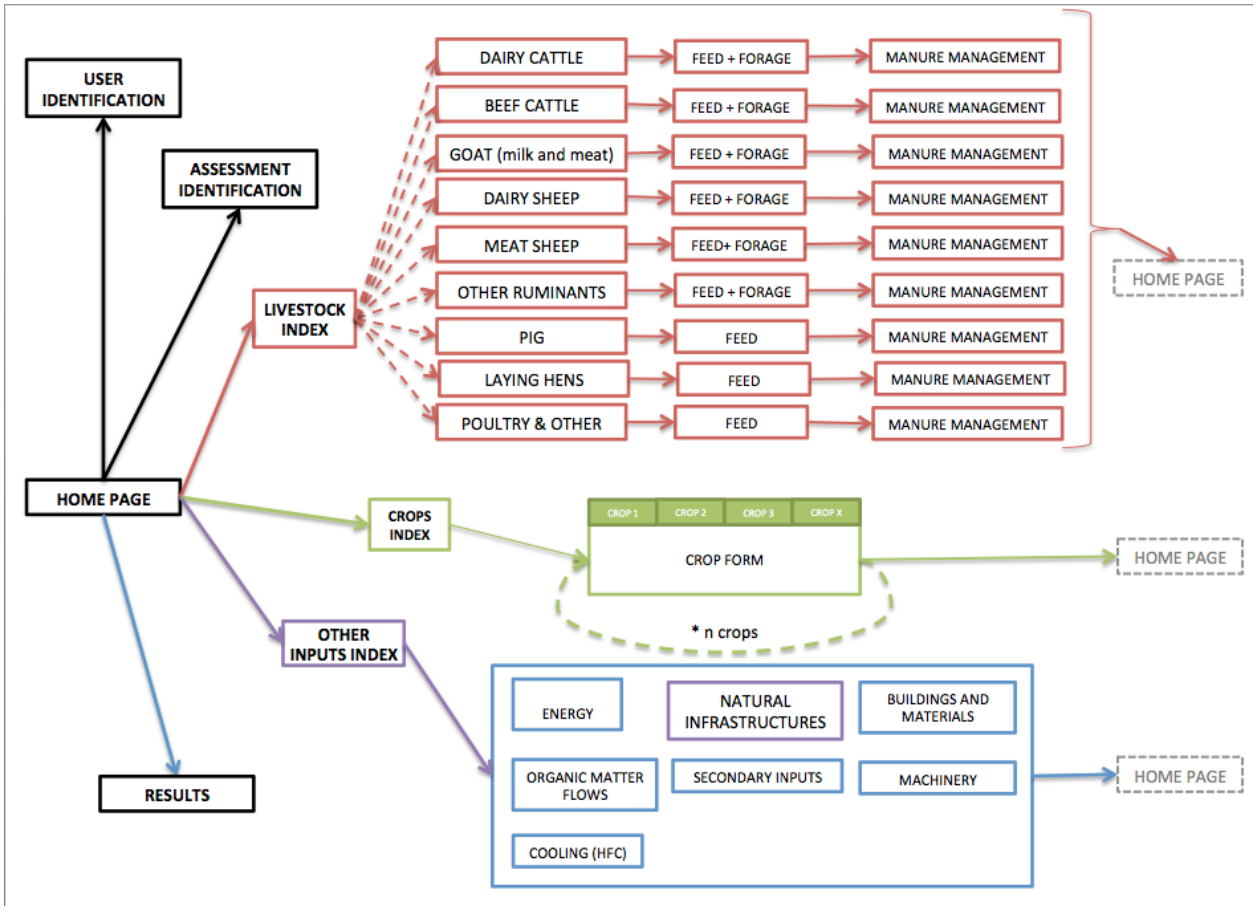


Figure 2: Navigation through the tool

Users can parameterise any crop, breeding type or "Other inputs" category they need. Also, it is possible, at any time, to modify the data previously entered in the Carbon Calculator.

1.4 "Save data" – "Import data" – "Help File" Buttons

1.4.1 Save data

To save an assessment, the user must use the button available on the main menu / Home Page (beware not to use the usual Excel save procedure).

Clicking on the "SAVE Data" button automatically creates an Excel file that contains the data of the on-going assessment. This new document is named based on the assessment registration information: *"CC_Farmer'sname_Year of assessment_Date of the survey_Date of saving file.xlsx"*.

Saving data takes around two minutes so b**e careful to wait for the message that indicates the end of saving before doing anything else on Excel** (don't click before getting this message).

The saved file is located **in the same folder** as the running Carbon Calculator. Once this file has been created, the user can follow the 'import data' procedure to restore his assessment (it has to be re-opened from a Carbon Calculator file).

1.4.2 Import data

The 'import data' procedure allows updating the emission factors and the calculation methodologies of the Carbon Calculator. Thanks to this procedure, data from finished or initiated assessments (previously saved with the "SAVE Data" procedure) can be restored in a new version of the Carbon Calculator from the Home page.

Clicking on the "IMPORT Data" button leads the user to browse his/her computer to find the saved file (*"CC_Farmer'sname_Year of assessment_Date of the survey_Date of saving file.xlsx")* of the assessment that the user wants to continue or update. When a new version of the Carbon Calculator is available, the user can update the farm's GHG assessment by clicking the "SAVE Data" button in the old version and then use the "IMPORT Data" button in the new version.

It is recommended that the user implement the "SAVE Data" procedure after any changes in the data entry of the assessment.

1.4.3 Help file

Clicking on the Help File button opens this user manual.

The file is precisely named "CC-UserGuidanceManual.pdf" (with no space between the words) and has to be located in the same folder as the Carbon Calculator. Moreover, it is mandatory to use Internet Explorer to open it.

On other screens, the "Help File" button directs the user to the corresponding section in the manual.

1.5 Remarks

User interface:

Depending on the module, the user is expected to implement four different types of actions in the Carbon Calculator:

- Enter a number in a specific box (for example, kg of Nitrogen per ha).
- Enter text in a specific box (for example, the Name of the farm).
- Select the suitable choice from a dropdown menu (for example, the country).
- Select the right answer to a question (for example, organic manure is spread on the crop: Yes/No).

The Carbon Calculator is able to determine if the Windows system settings imply the use of a comma or a full stop on extended numeric data, provided that Excel uses the same settings as Windows. Therefore, users should check that this is the case.

Data quality / relevance:

The user is responsible for ensuring the quality of the data entered into all modules of the tool (accuracy, relevance…). Any error in data input will affect the accuracy of the assessment produced by the Carbon Calculator. The tool will not always issue warnings when inaccurate / irrelevant data is entered (for example: be careful to use numerical data for figures, ensure percentages are always lower than 100, etc.).

Emission factors in the tool are parameterised per input. It is therefore very important that the user respect the default units within the tool.

Allocations:

The tool relies above all on the traceability of inputs used to allocate related GHG emissions to different products. In some situations, when there is a direct link between the source of emissions and the products, the Carbon Calculator automatically allocates the emissions to the product.

In some cases the Carbon Calculator asks the user to distribute the percentage of use of an input between the different products of the farm. In this case, it is really important for the user to ask the farmer about the final distribution of use of this input between products.

Data input priority:

In the Carbon Calculator, some modules are of high priority for the accuracy of the GHG assessment since they usually correspond to significant GHG emissions on farms. These high priority modules include: Assessment registration, Livestock, Cropland and Energy (in the 'Other inputs' module). It is important that the user takes the necessary time to complete these modules.

Other modules can be considered of less importance to the estimation of total GHG emissions from the farm: Farm buildings, Machinery, Secondary inputs or Natural infrastructures. However, users should remember that they have to complete these modules to calculate relative GHG emissions from different sources. There is no default value for them. If specific data is not added in these forms, the detailed GHG result is zero for them.

An asterisk (*) in the boxes indicates mandatory data. If data is forgotten or not in the right format (numeric, decimal, date, text. etc.), message boxes appear for the user to correct these data or to validate a question.

Results:

The Carbon Calculator reports GHG emissions as total emissions per functional unit.

The results are reported at farm level using 'ha UAA (Utilised Agricultural Area) as a functional unit (Figure 3). The annual change in carbon stocks (soil and natural infrastructures) is calculated in addition to gross GHG emissions (Figure 4).

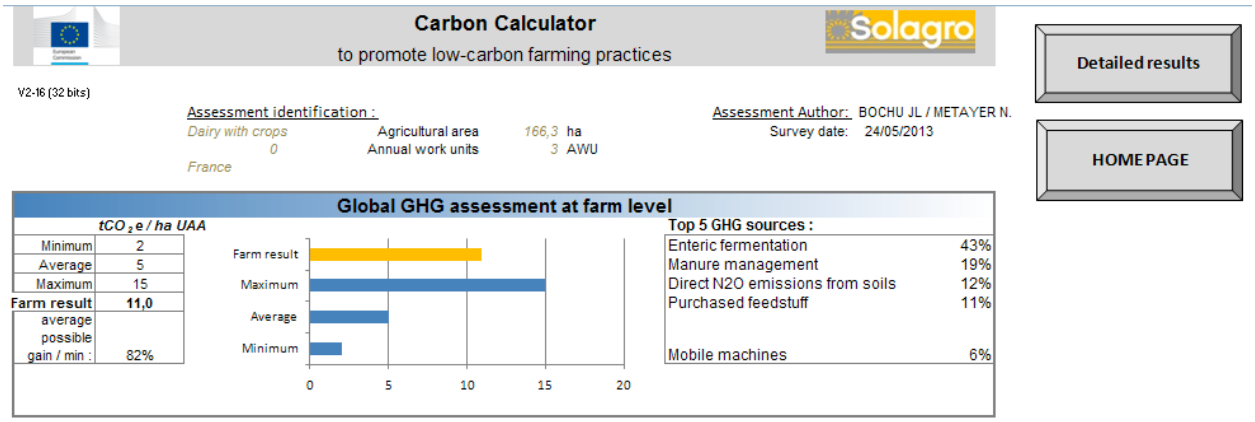


Figure 3: GHG emissions at farm level

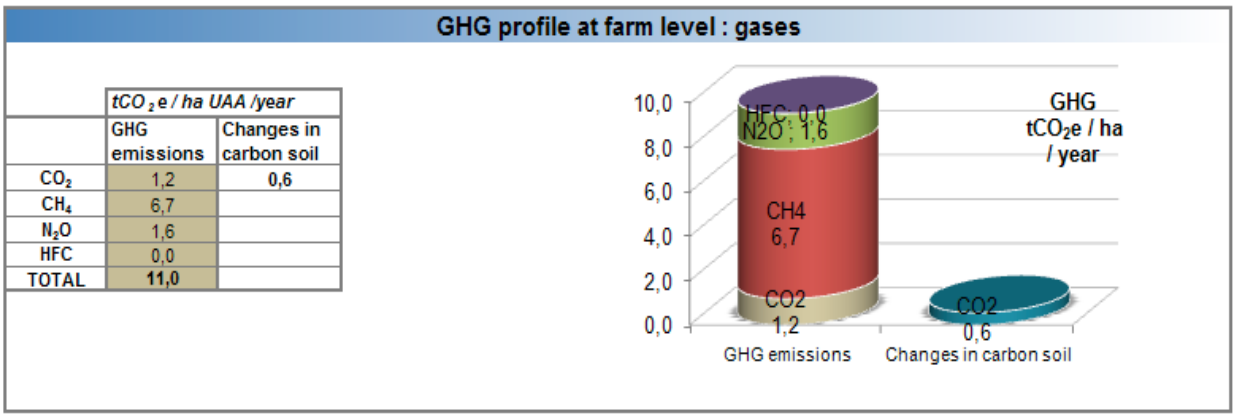


Figure 4: GHG profile at farm level

In a second step, GHG results for the five main products of the farm are presented (Figure 5). A suitable functional unit is used depending on the product (tonne of milk, tonne of live weight meat, tonne of dry matter, tonne of fresh matter).

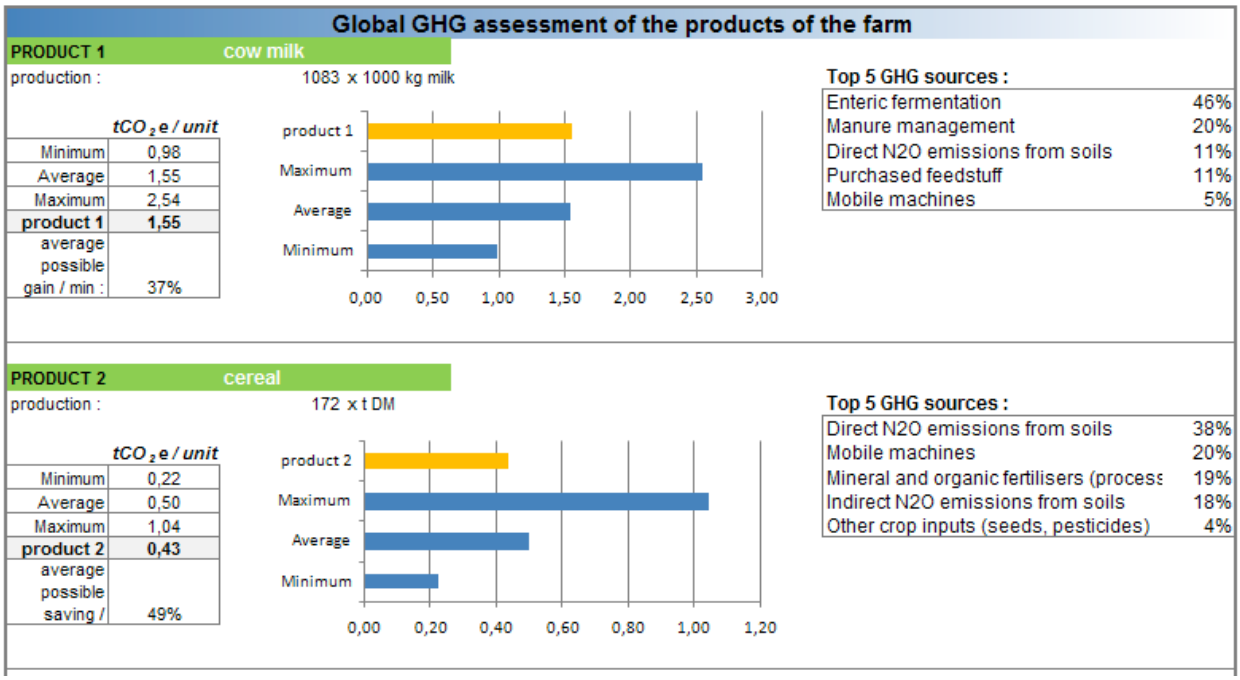


Figure 5: GHG results by product (1 and 2 for example)

2 Carbon Calculator modules

Help buttons included in the different forms are directly linked to relevant pages in the User guidance manual.

2.1 User identification

The aim of the module is to identify the person in charge of the assessment.

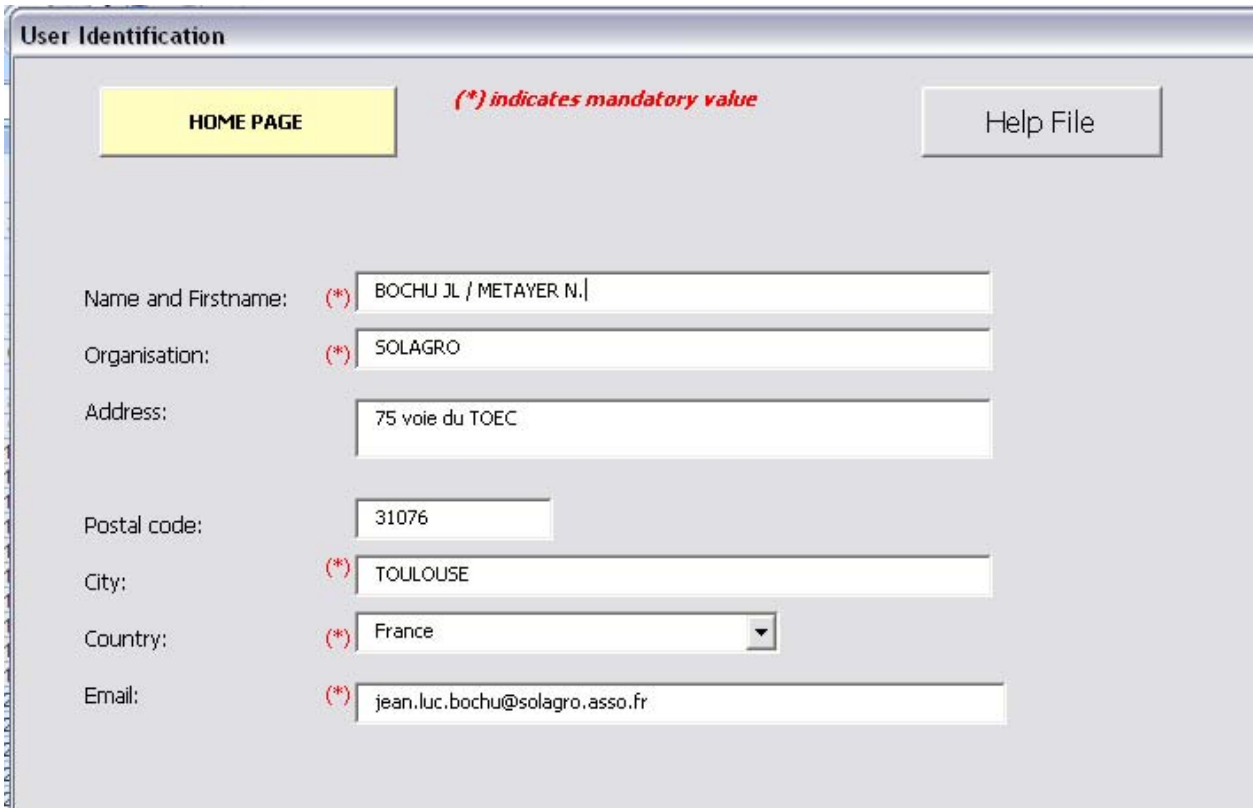


Figure 6: User identification

Figure 6 shows the required information: name of the investigator, organisation, address, zip code, city, country, telephone number, mobile phone number and E-mail.

2.2 Assessment registration

The assessment registration module is divided into three parts, as detailed below. The complete screen is visible with scrollbars on the right and at the bottom.

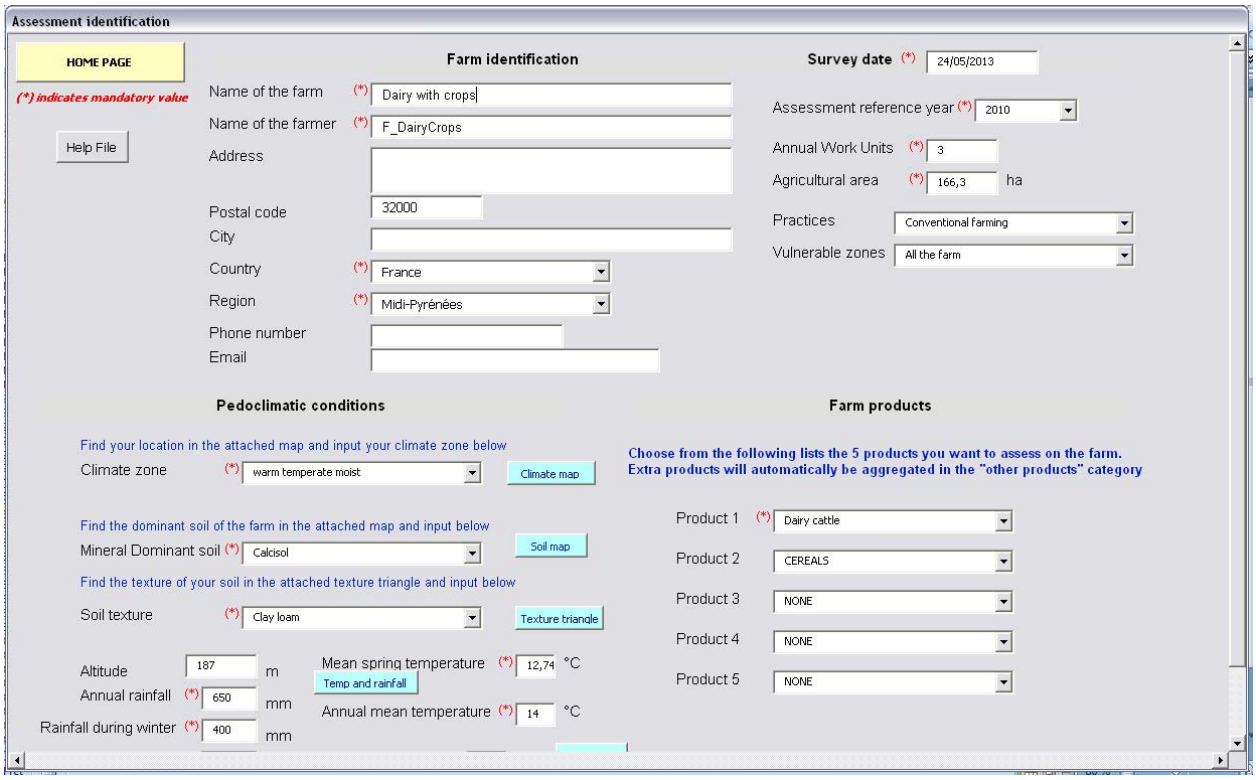


Figure 7: Assessment registration module (upper part)

2.2.1 Assessment identification

The upper part of Figure 7 is devoted to the assessment identification:

- Name of the farmer (and name of the farm if it has one), address, zip code, city, phone number and E-mail.
- Country and region (NUTS 2 level) where the farm is located (selection from a drop down menu).
- Practices: organic, conventional, conservation and integrated (selection from a drop down menu).
- Nitrate vulnerable zone: totally, partly and not concerned.
- Assessment reference year: the user should consider the harvest year (not a calendar year necessarily).
- Agricultural area in ha.
- Annual Work Unit (AWU) of the farm.

The user should pay particular attention to collecting the exact agricultural area of the farm, as it is one of the functional units used for the results at the farm level.

2.2.2 Pedoclimatic conditions

The Assessment identification form also gathers information dealing with pedoclimatic conditions of the farm, in the left part and at the bottom of the screen (use the scrollbars to show them if needed).

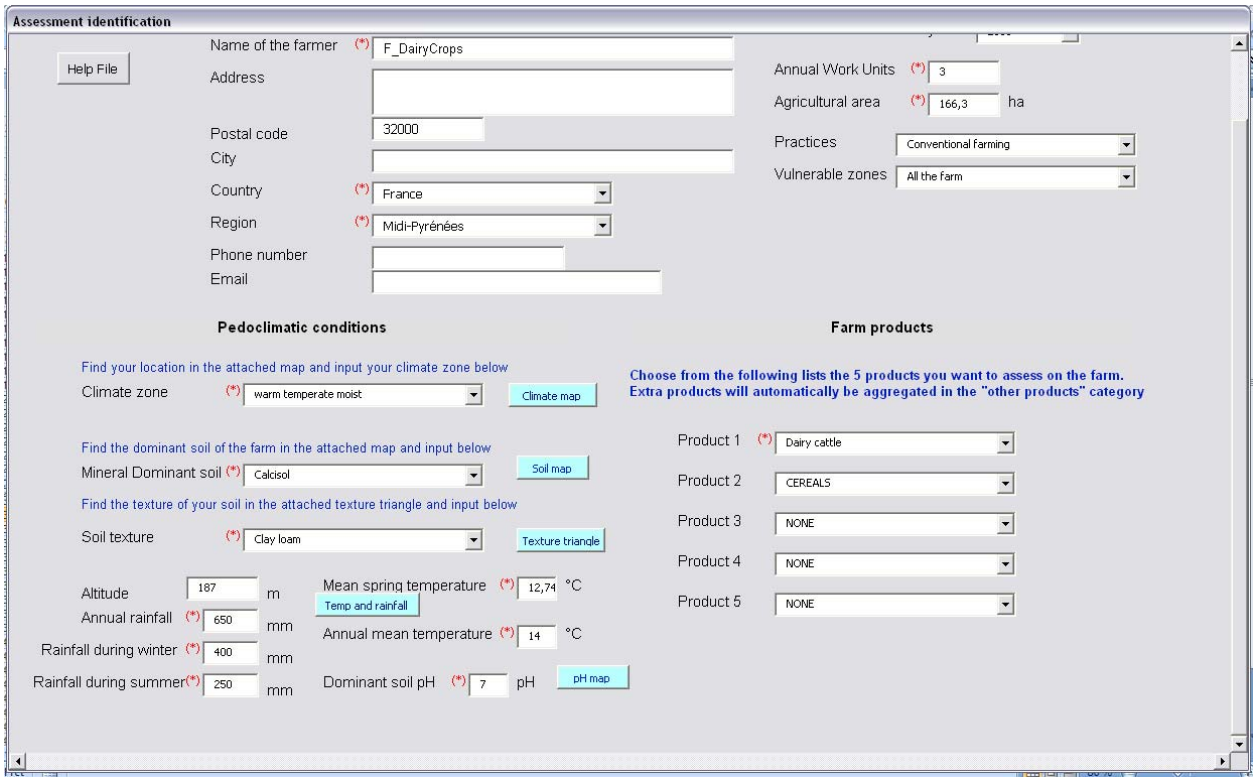


Figure 8: Assessment identification (lower part)

Climate zone:

The 'Climate map' button opens a picture that helps the user select the suitable climate zone for the assessment (Figure 9).

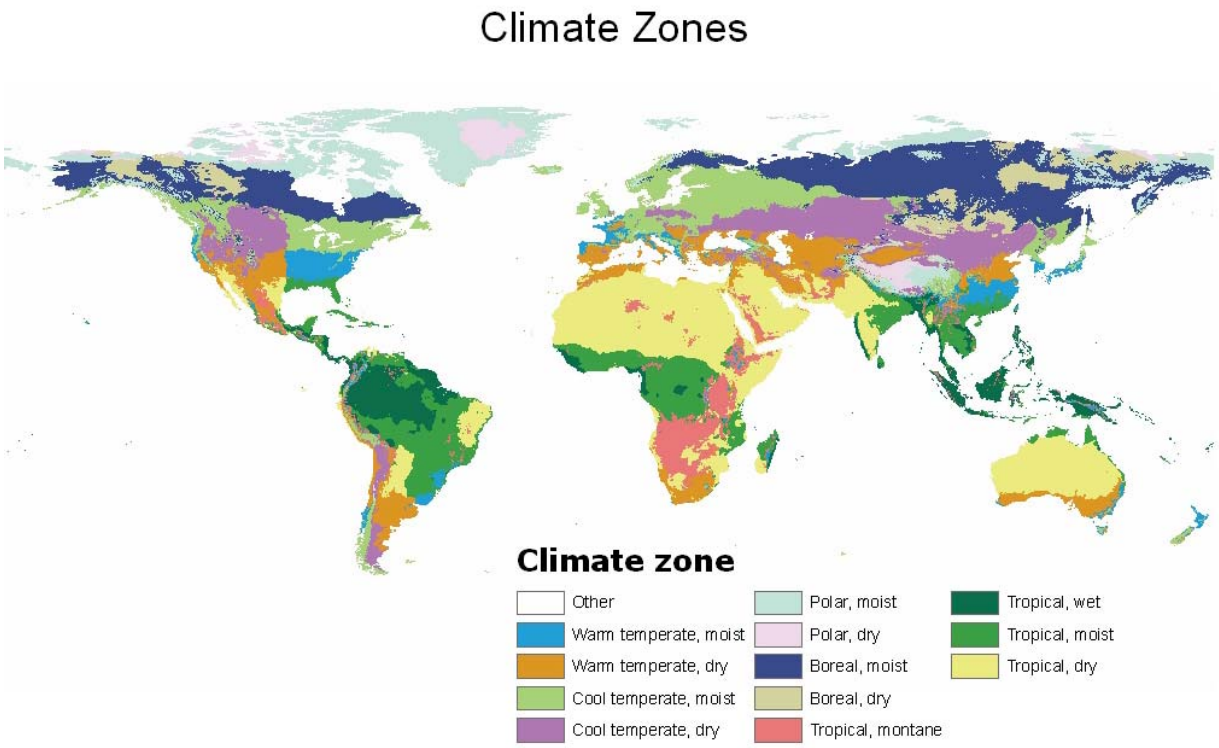


Figure 9: Climate zones

Mineral Dominant soil:

The Soil map button links to the map above, originally available on the JRC's website (http://eusoils.jrc.ec.europa.eu/ESDB_Archive/ESDBv3/GoogleEarth/index.cfm), where the user can download a Google Earth File that corresponds to maps derived from the European Soil Database v2 (ESDB v2) for EU-27 countries.

The suitable map is called WRB-LEV1 (Figure 10) and refers to soil reference group codes of the STU[1] from the World References Base (WRB) for Soil Resources. It will help the user to precisely identify the suitable type of soil of the farm within 30 categories.

[1] STU: Soil Typological Unit

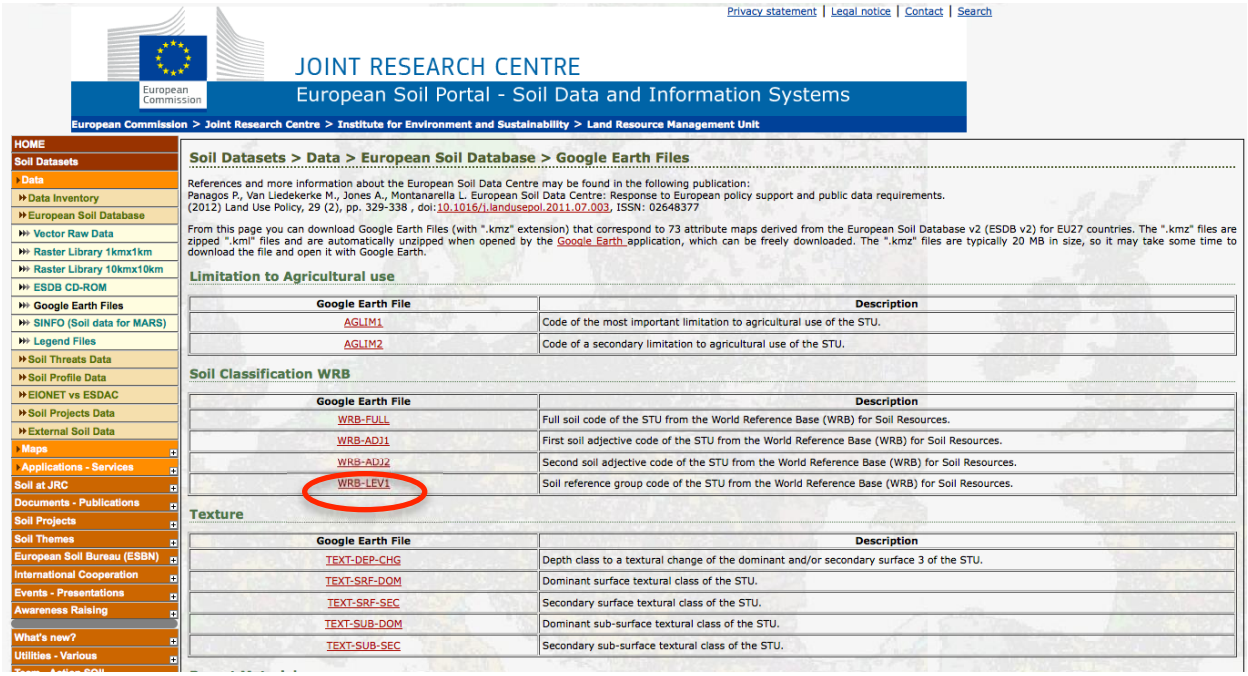


Figure 10: JRC, European Soil Portal

Temperature and rainfall:

It is advisable to use a tool like the FAO's New LocClim to quickly find the required meteorological data. New LocClim is a freeware tool to estimate local climatic conditions for any location on Earth.

http://www.fao.org/NR/climpag/pub/en3_051002_en.asp

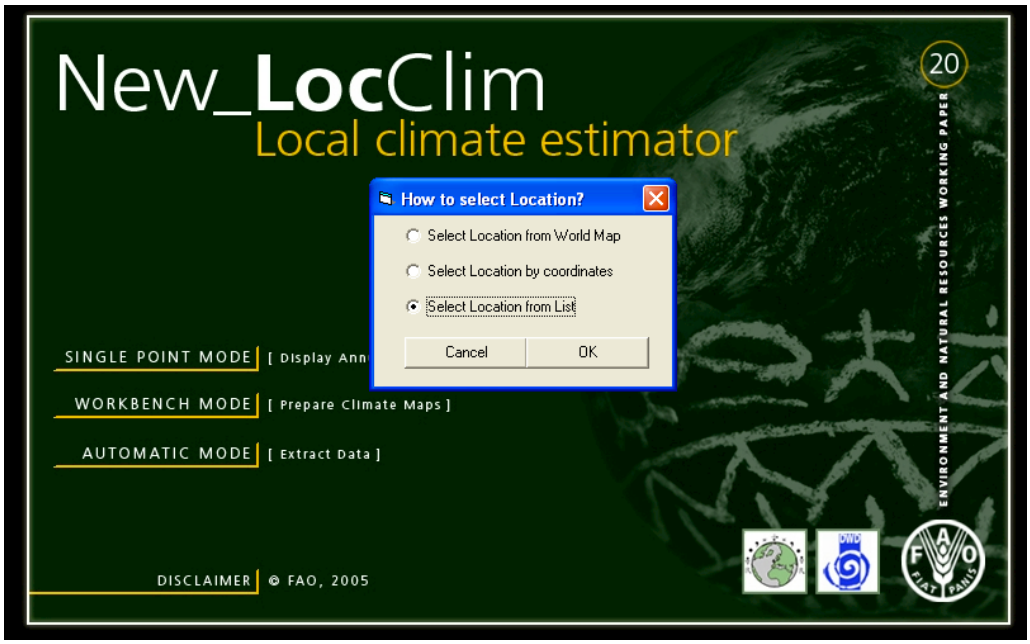


Figure 11: FAO freeware tool New_LocClim

- Annual rainfall (mm)
- Rainfall during winter (mm)
- Rainfall during summer (mm)

- Annual mean temperature (°C): the user has to enter the mean temperature of the 3 months that begin after the first 400°C days of a calendar year. Table 3 (in Annex) gathers default values that are available at NUTS2 level (mean temperature from 2007 to 2011).

Soil pH:

The dominant soil pH of the farm is required. If the farmer is not aware of it, the user can identify it on Figure 12. The volatilisation from synthetic fertiliser is higher if soil pH is higher than 7.0.

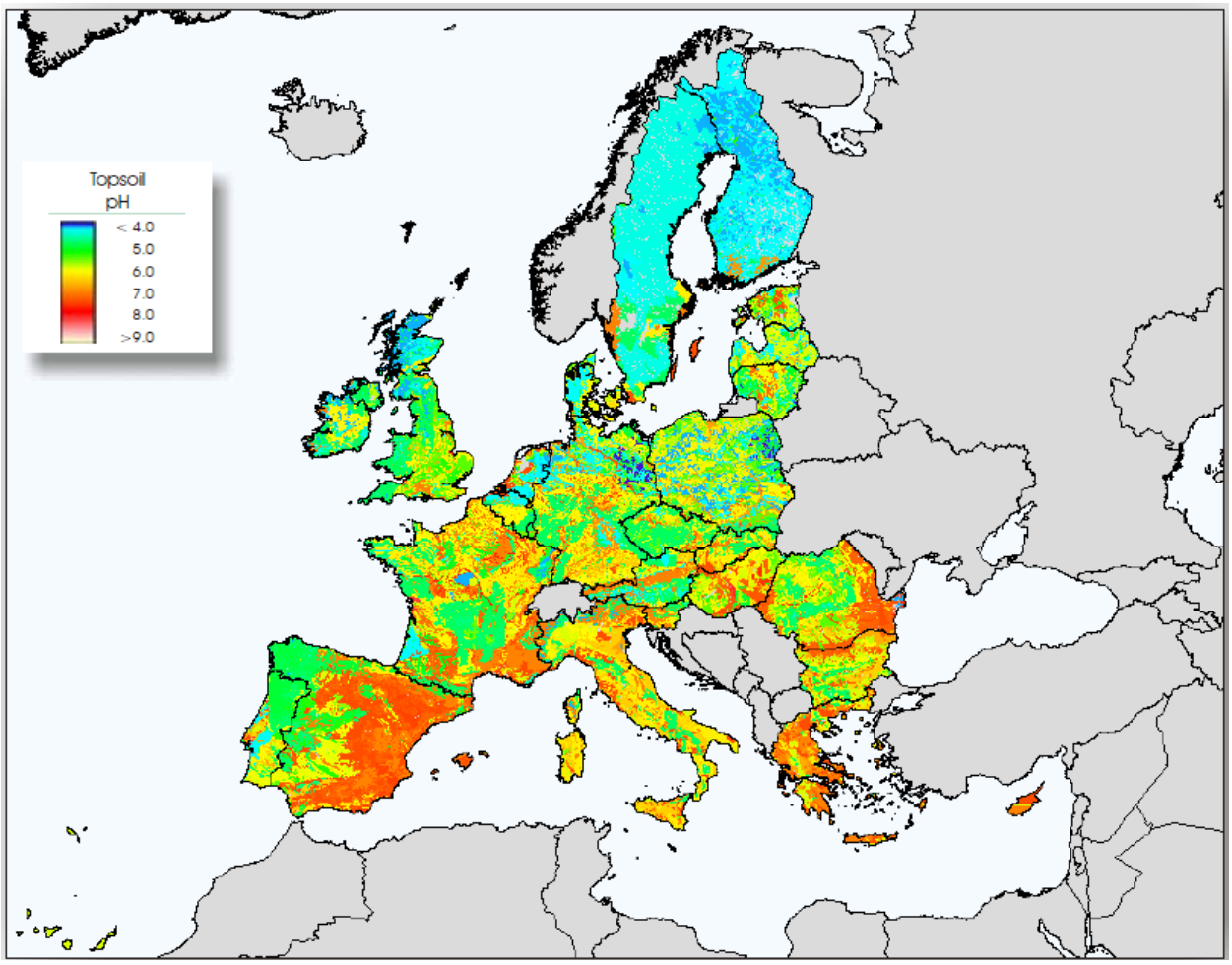


Figure 12: Soil pH in Europe, JRC

Soil texture triangle:

The user has to characterise the soil texture of the dominant soil of the farm. Figure 13 can help the user to identify the suitable texture category from silt%, sand% and clay%.

The Carbon Calculator will automatically match the soil texture with a suitable field capacity and the effective rooting systems, which are useful for estimating nitrate leaching and runoff.

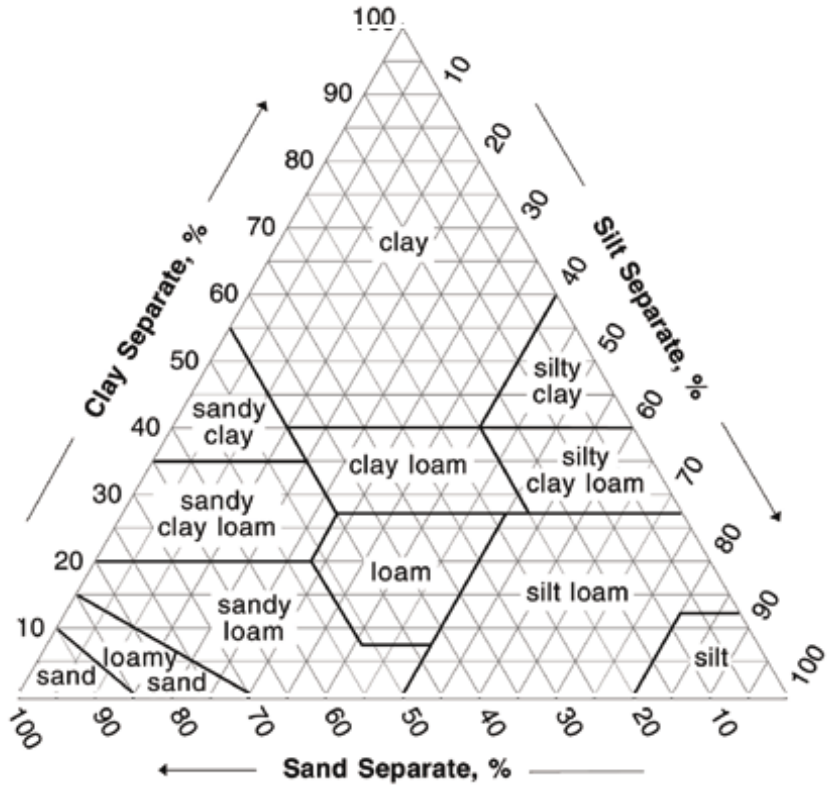


Figure 13: Soil texture triangle (USDA, soil survey staff, 1951)

Altitude:

The user can specify the farm altitude (m).

2.2.3 Farm products

To collect all data required in the assessment identification module (Figure 8), the user has to define the relevant products of the farm. What is considered to be a product corresponds to its physical form at farm gate (before processing).

The product portfolio is limited, in the Carbon Calculator, to the five most relevant products of the farm. The user can select up to five different products in a pre-defined list (Table 1). A sixth category named “other products” is always present.

Some products have co-products. In the Carbon Calculator, these products are milk (always associated with meat), and eggs (associated with meat). The user cannot select these co-products.

If the user selects cereals and milk as its two main products, the calculator automatically creates “dairy meat” as the third product of the farm. In the case where the user had already

selected five main products, the “dairy meat” product is not created and related emissions are reported in “other products”.

Table 1: Available productions in the Carbon Calculator and corresponding products

Productions	Products
Dairy cattle	Cow milk + meat
Dairy sheep herd	Sheep milk + meat
Meat sheep herd	Sheep meat
Dairy goat herd	Goat milk + meat
Beef herd	Beef meat
Other ruminants	Other meat
Pigs	Pork meat
Poultry	Poultry meat
Laying hens	Eggs + laying hens meat
Cereals	***All cereal grains***
Barley	Barley grain
Maize	Maize grain
Sorghum	Sorghum grain
Hard wheat	Hard wheat grain
Soft wheat	Soft wheat grain
Lupine	Lupine grain
Millet	Millet grain
Oat	Oat grain
Peas	Peas grain
Rape	Rape grain
Rice	Rice grain
Rye	Rye grain
Soya	Soya beans
Sunflower	Sunflower grain
Triticale	Triticale grain
Spring field bean	Spring field bean grain
Winter field bean	Winter field bean grain
Industrial crops	***All industrial crop grains***
Potatoes	Potatoes
Tobacco	Tobacco
Sugar beet	Sugar beet
Wine	Wine
Grapefruit	Grapefruit
Fruits	Fruits
Vegetables	Vegetables
Fodder	Fodder plants

Note: this list is available for the user. The administrator can define additional products (maximum 60).

Remarks:

- Cereals: the user can consider all of them in one product group called “Cereals” or analyse them (or some of them) separately (product by product).

- The user can select each product or product group only once from the drop down list. For example, soft wheat can only appear once among the five products of the farm.
- Meat from dairy cows, goats or sheep that produce milk is considered as a mandatory product of the farm if the user selects cow, sheep or goat milk.
- After the five main products have been identified, GHG emissions linked to other products are automatically allocated to a sixth category called “Other products”. GHG emissions for that category are not calculated per unit of product but per unit of land area (ha).

Examples of selecting products and product groups for different farming systems:

Farm type 1:

110 ha of cereals with wheat (40 ha), barley (30 ha), rape (35 ha) and landscape elements (5 ha).

Three possible combinations exist: analyse cereals all together in a same product group (1) or analyse some of them separately (2 and 3), with a maximum of five different cereals.

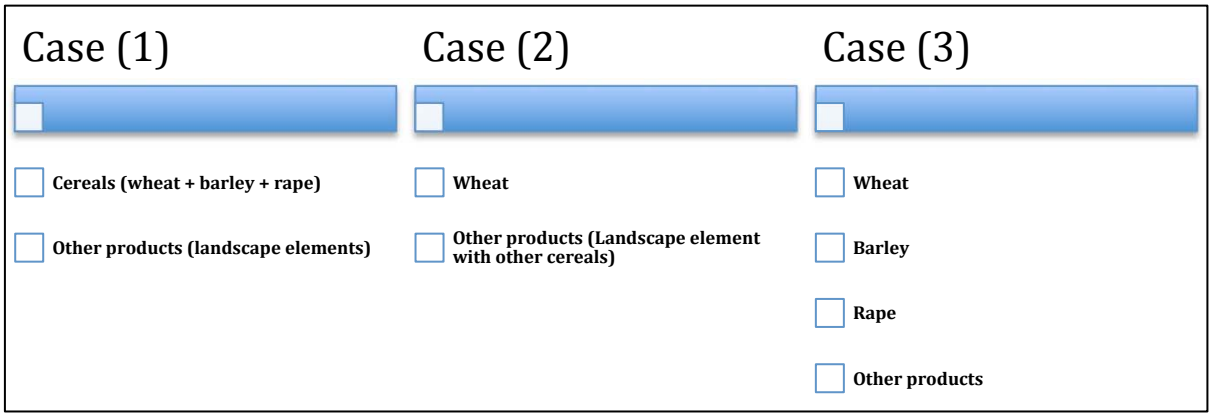


Figure 14: Examples of production or product selections for a grain farm

The results of the GHG assessment are shown for the products:

- Example 1: product 1: cereals (all together) and other products
- Example 2: product 1: wheat (only) and other products
- Example 3: product 1: wheat; product 2: barley; product3: rape and other products.

Farm type 2:

Dairy farm with only milk and meat from dairy cattle.

In this case, meat from dairy cows is considered as a mandatory product of the farm: the user only has to select cow milk as a product.

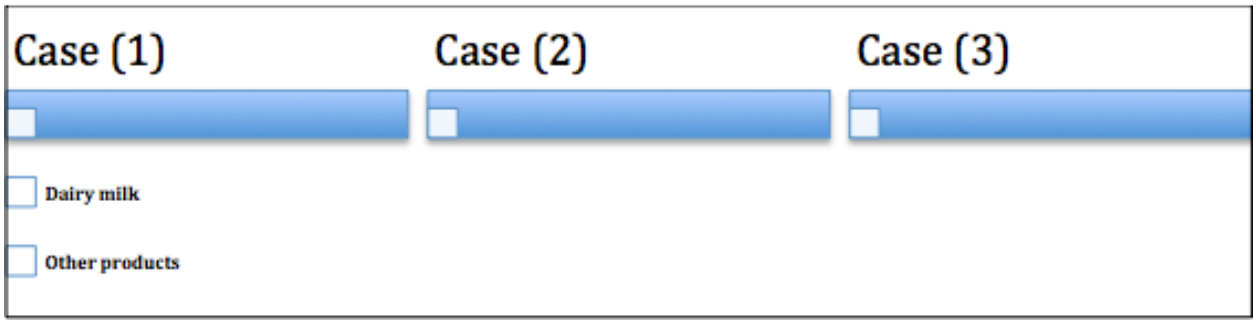


Figure 15: Example of selection of production for a dairy farm.

In this case, “Dairy meat” is automatically created as a second product of the farm. The first one is milk. The “other products” category gathers all other emissions.

2.3 Other inputs

The other inputs index gives the user access to six different categories (Figure 16): Direct energies, Natural infrastructures, Buildings and materials, Organic matter flows, Secondary inputs, Machinery and Cooling, refrigerant and air conditioning systems. The user has the possibility to select any of the mentioned categories (no imposed pathway) or to come back to the home page (home page button).

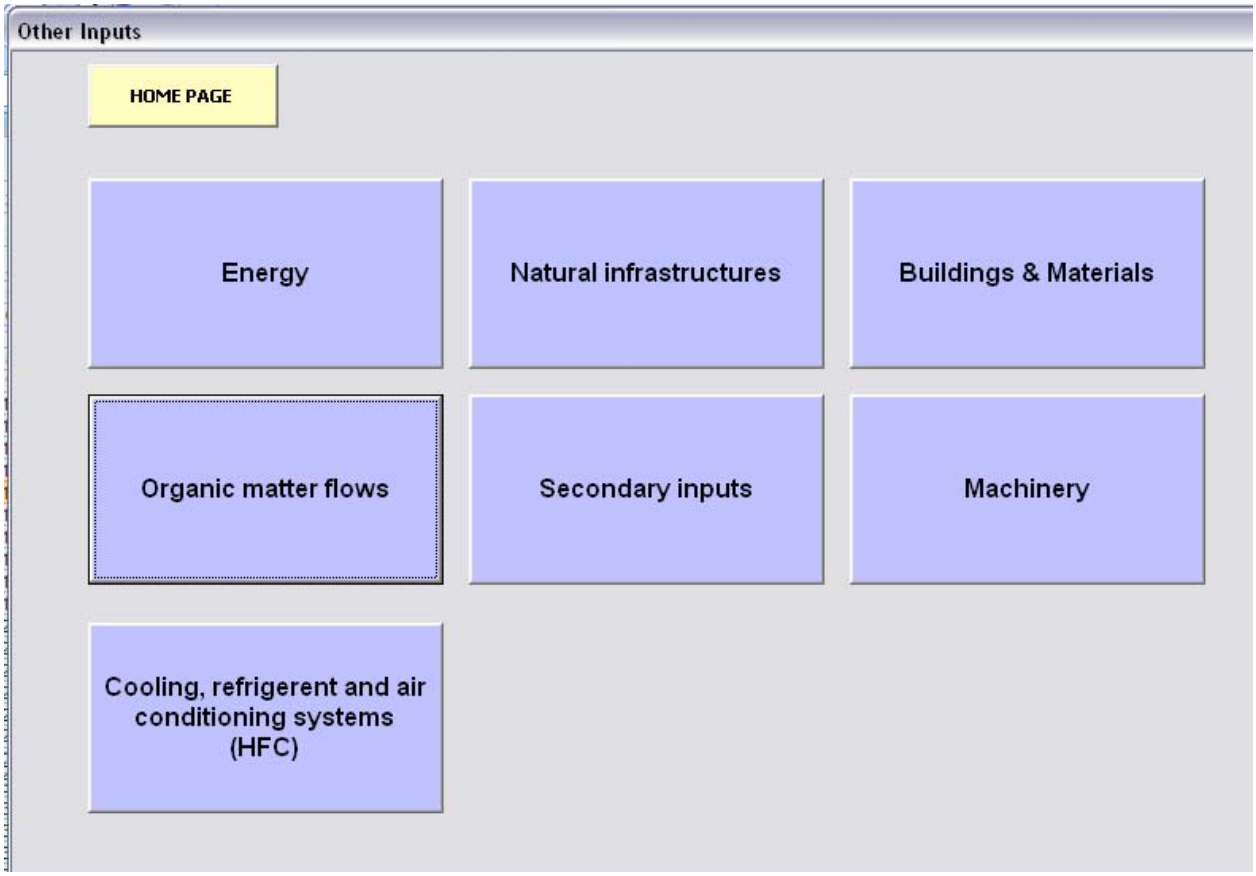


Figure 16: Other inputs index

The different categories are described in the following chapters.

2.3.1 Direct energy consumption and renewable energy

The first tab of Figure 17 is devoted to fuel consumption of the farm.

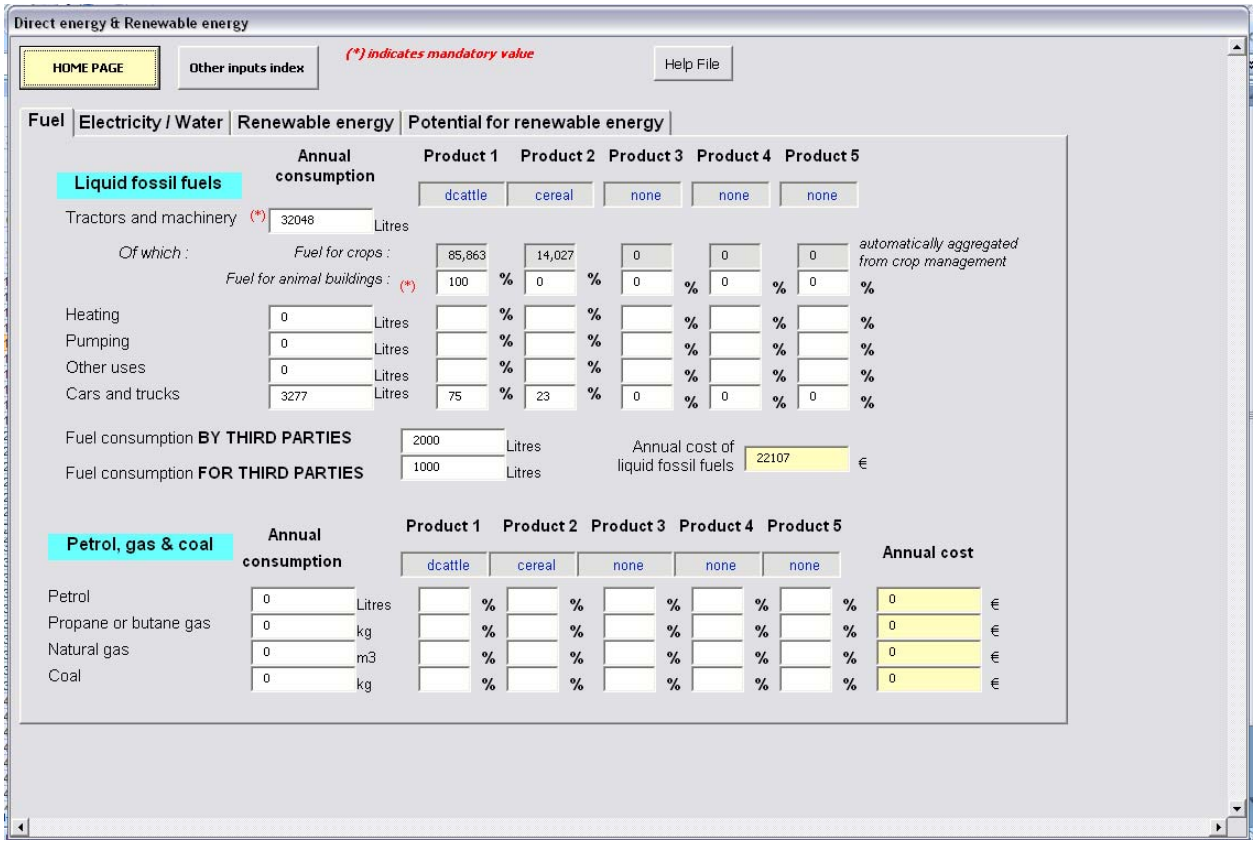


Figure 17: Consumption of gas, and solid and liquid fuels

In this form, the user is expected to focus on professional consumption of non-renewable energies. The energy consumption for residence buildings should not be included: the user should pay particular attention when both uses share the energy bills (as is sometimes the case for electricity, diesel, etc.).

The user shall therefore enter the consumptions of each fuel during the year of reference, taking into account the specific units for each category (litres, kg or cubic metres).

For liquid fossil fuels, the user can specify agricultural uses:

- Tractor and machinery (fuel used for animal buildings must be specified under that category. Grey cells are automatically filled in based on data entered in the “Cropland” module)
- Heating,
- Pumping,
- Cars and trucks
- Other uses.

It is mandatory to enter a value higher than zero in the fuel use of tractors and machinery. If the farm uses contractors for all fieldwork a nominal value of one should be used. If the value is zero, error messages will appear in the results.

As fuel consumption by or for third parties forms part of the assessment, it is advisable for the user to use ratios of fuel (litres/ha) by type of crop activity to estimate these amounts. When applicable, the user shall apply local ratios.

In the case of fuel consumption by third parties, its quantity is automatically added to the quantity used by the farmer.

Finally, the user has the possibility to fill in data about annual costs.

The second tab on Figure 18 is devoted to electricity and water consumption.

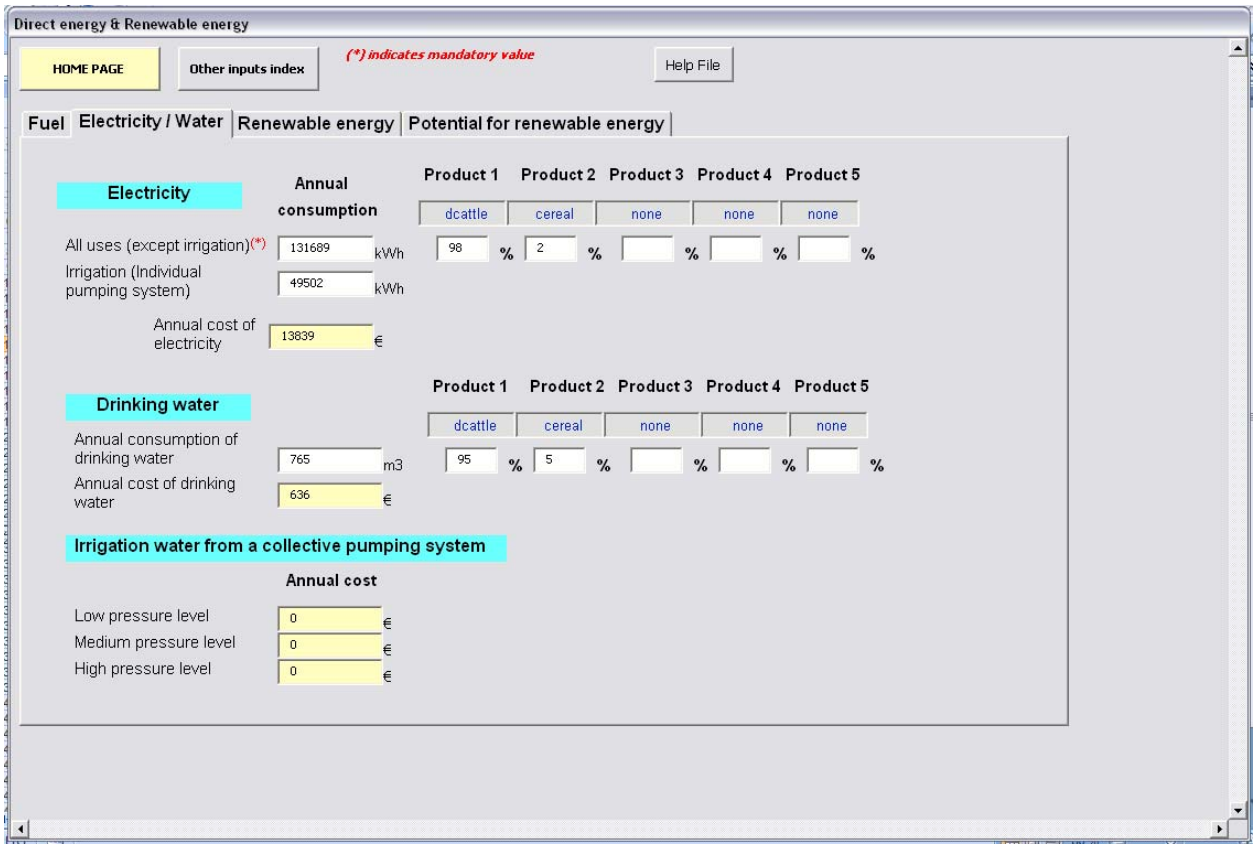


Figure 18: Electricity and water consumption

Electricity:

The user can use invoices to determine the annual consumption of the farm in kWh (the expected unit in the Carbon Calculator for electricity is kWh).

The user has to be careful as electricity use for irrigation is separated from electricity use for other uses. Generally, in the case of an individual irrigation system on a farm, an individual grid for electricity allows to identify the specific use of electricity.

The Carbon Calculator automatically allocates the electricity use for irrigation to irrigated crops whereas the user has to allocate other electricity uses to relevant products (% of use per product).

Drinking water:

For drinking water, the user has to identify the number of cubic metres consumed and allocate its use in percentage between the different available products of the farm.

The user can also fill in the data about annual cost for electricity, drinking water and irrigation water from a collective pumping system.

The second tab on Figure 19 is devoted to renewable energy consumed on the farm and sold from the farm. The aim is to calculate avoided GHG emissions due to the use of renewable energy.

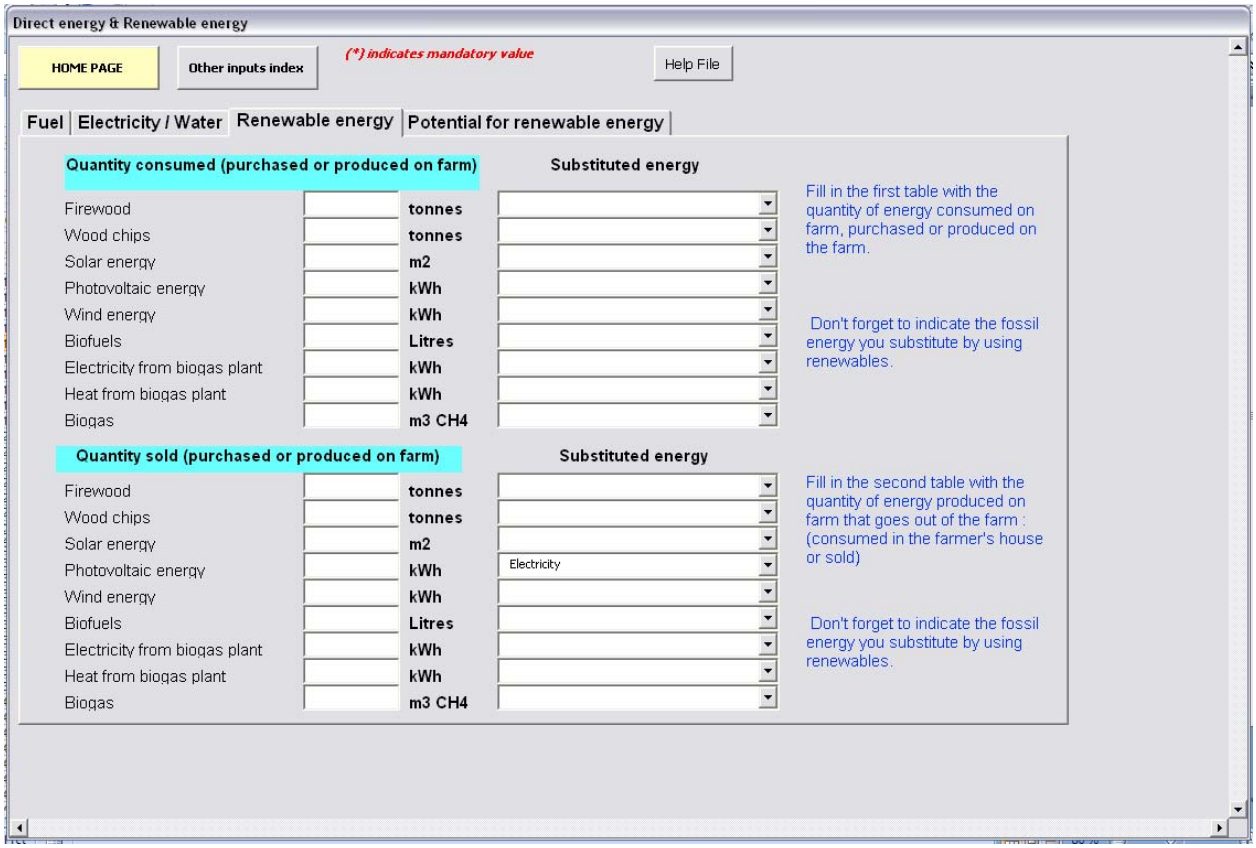


Figure 19: Renewable energy consumed and/or sold on the farm

First, the user has to indicate the quantity of renewable energy consumed or sold, using the required units. Then, a drop down menu allows the user to select the fossil energy that is substituted.

Finally, additional information is required to calculate some mitigation actions, including: details of heating needs on the farm (greenhouses or buildings), hot water use (dairy farms, etc.)

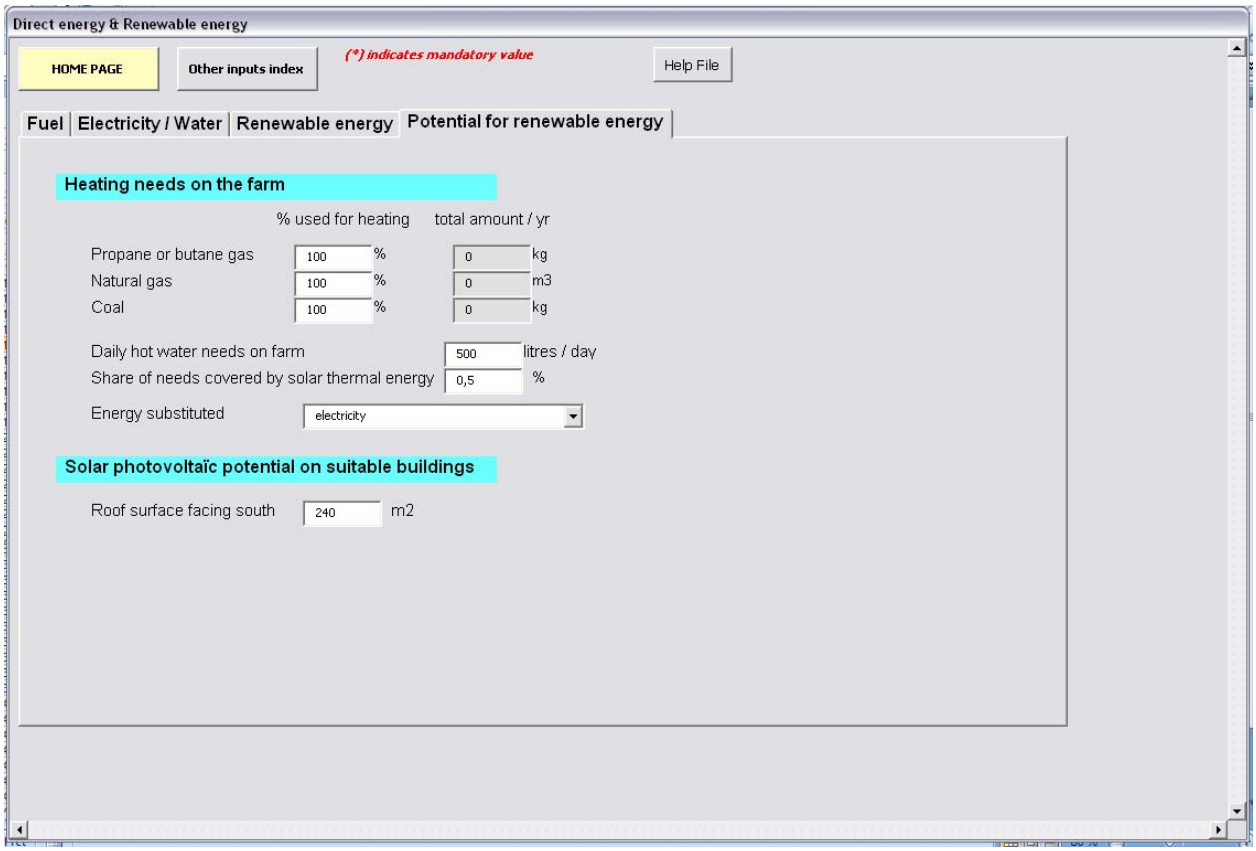


Figure 20: Data for renewable energy potential

2.3.2 Natural infrastructures

This module is split into two different tabs: natural infrastructures and land-use change (Figure 21). The aim of this module is to estimate the changes in carbon stock in natural infrastructures and soil.

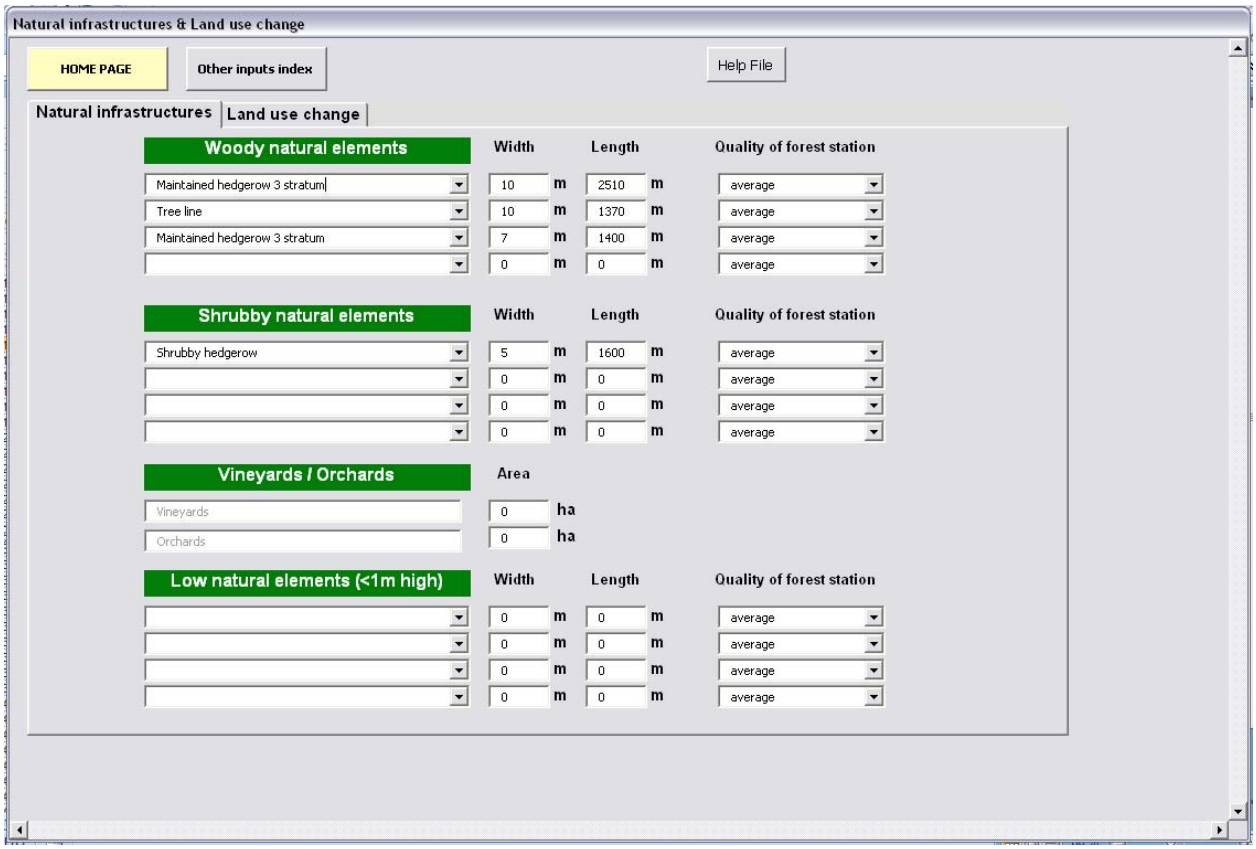


Figure 21: Natural infrastructures

Natural infrastructures are divided in three categories (Figure 21):

- Tree natural elements (more than five meters high).
- Shrubby natural elements (one to five meters high) including vineyards and orchards.
- Low natural elements (less than one meter high).

Woods and forests (surface higher than 0.2 ha) are not considered here as they are outside of the scope of this Carbon Calculator.

For each category, the user has to identify the width and length (m). The user should note that for forestry statistics, the surface is counted by projection on the ground of the tree crown.

In addition to the surface, the user has the possibility to indicate the rate of increase (annual growth) in three levels: favourable, average, and unfavourable. This data describes the quality of the station.

For vineyards and orchards, the surface in ha is the only data required.

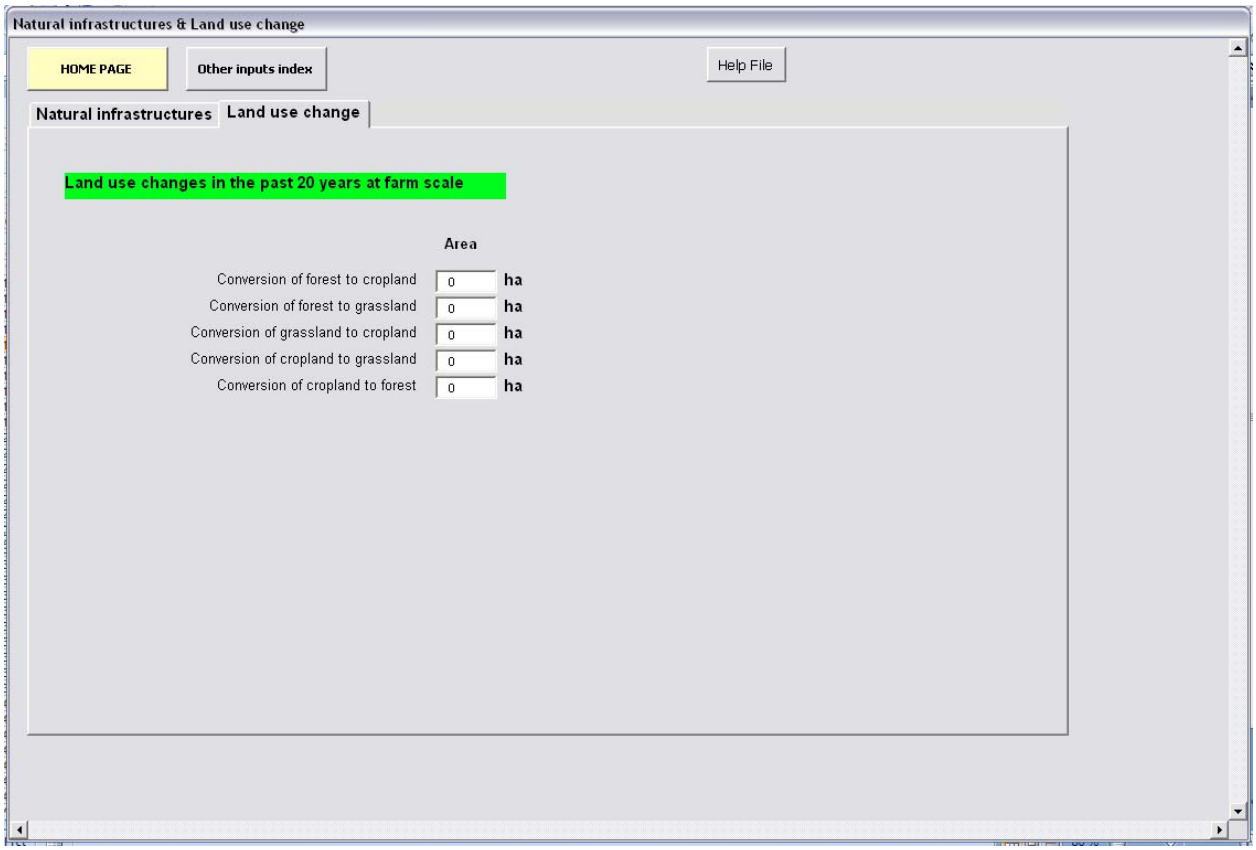


Figure 22: Land use changes in the last 20 years at farm level

The user has to describe the land-use changes having taken place over in the past 20 years at farm level (Figure 22). The surface in ha is required for each suitable category.

2.3.3 Farm buildings and materials

This module is split into three different tabs (Figure 23):

- Buildings 1, corresponding to farm buildings that are directly linked to corresponding products by the Carbon Calculator
- Building 2, corresponding to other farm buildings not automatically linked to products
- Materials

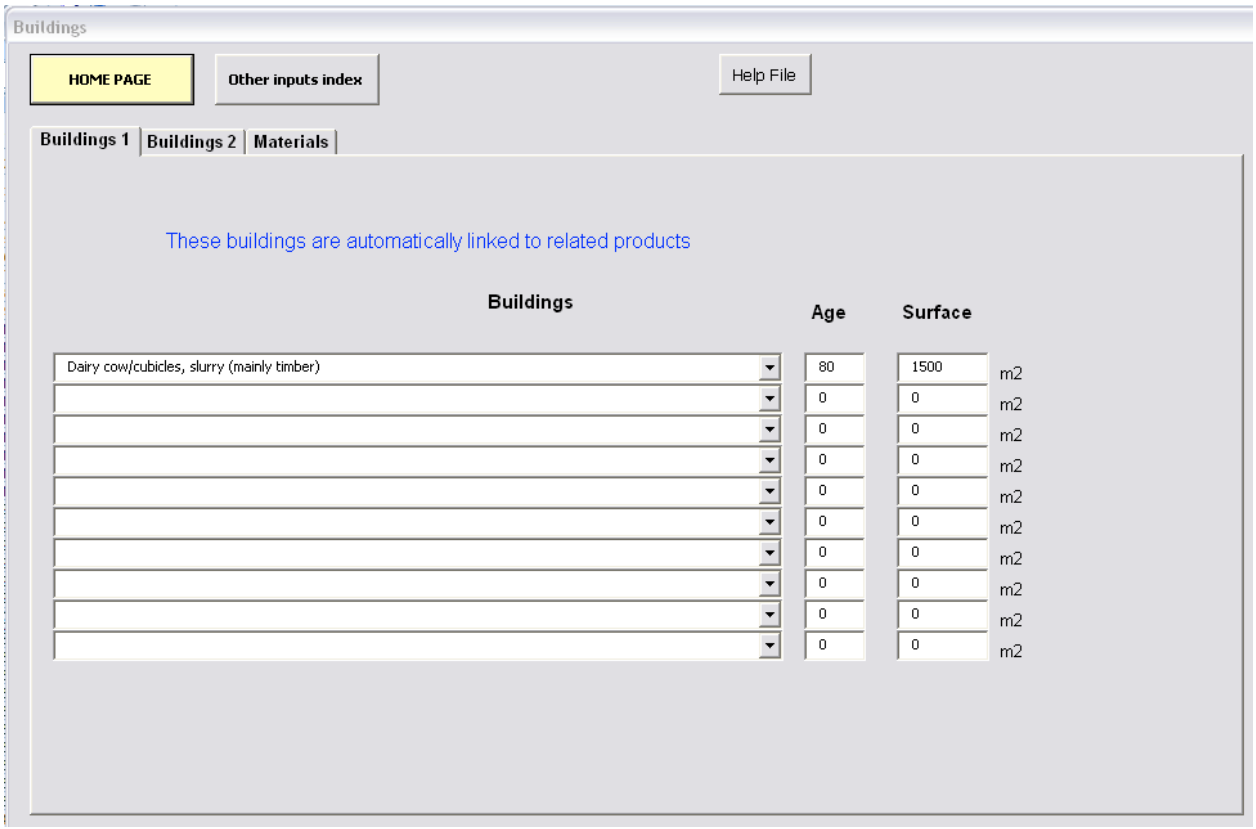


Figure 23: Farm buildings automatically distributed to products

The list of farm buildings includes many building types: barns, sheep-pen, poultry house, pig house, greenhouse, storage building for potatoes, etc. The user can select the suitable farm building from a drop down menu.

For each farm building, the user needs to mention the age of the building (in years) and the surface in square metres.

The second tab of the module is devoted to other farm buildings (Figure 24).

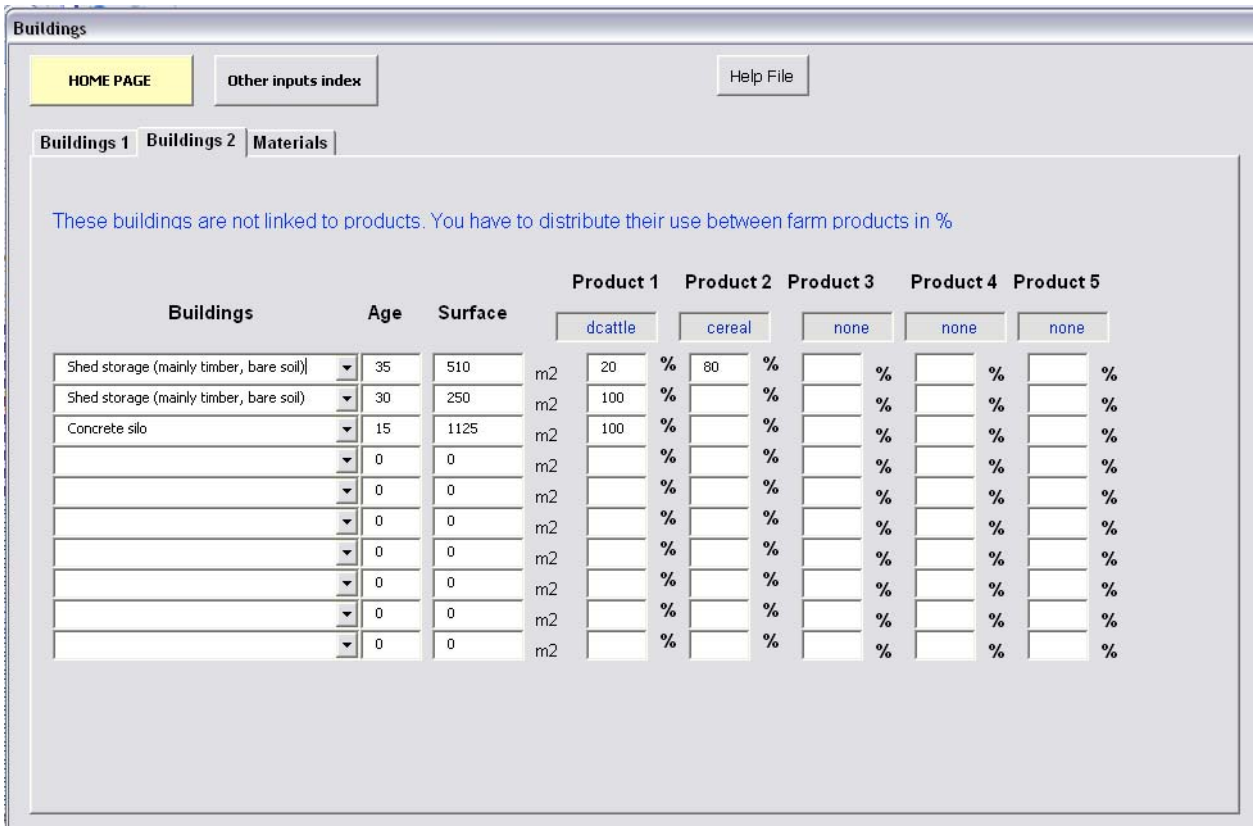
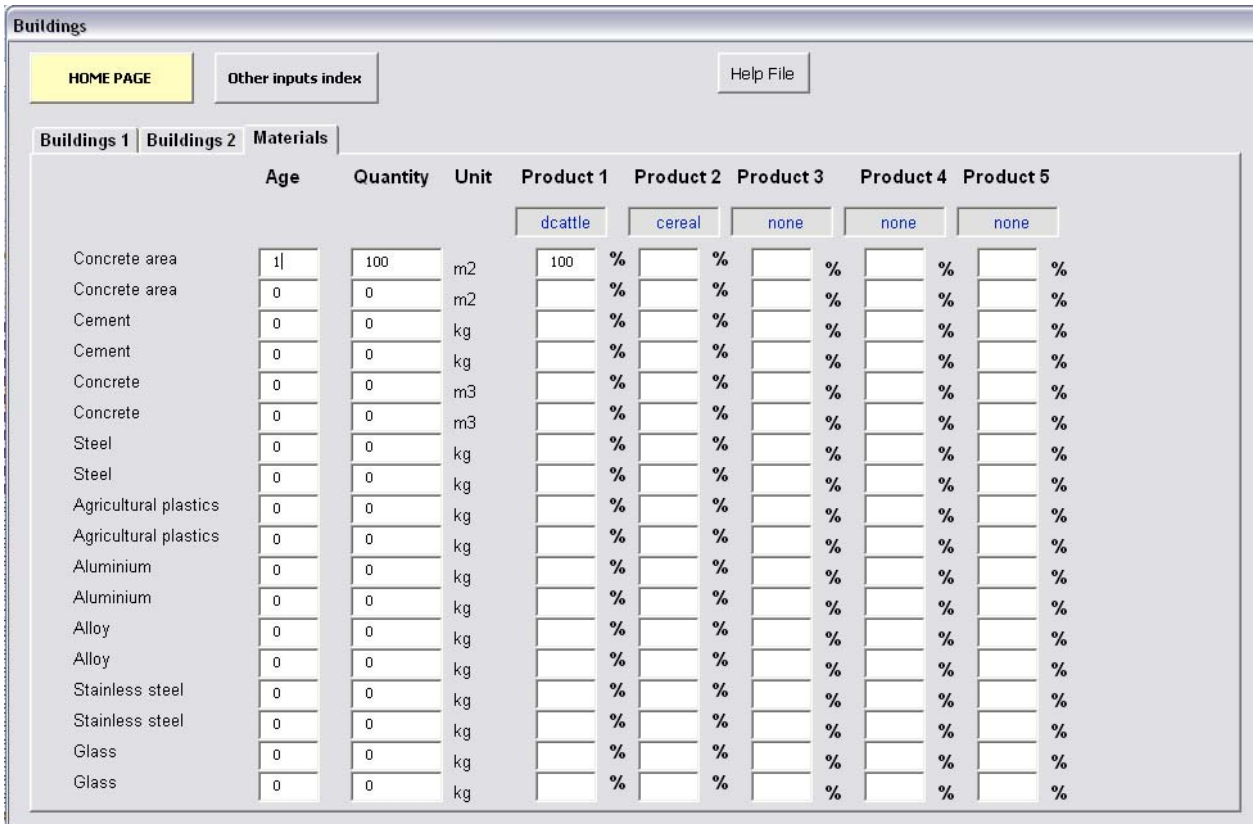


Figure 24: Farm buildings not automatically linked to products

This list of farm buildings mainly includes different types of shed storages but also a concrete silo, a cold room, etc. The user can select the suitable farm buildings from a drop down menu.

For each farm building, the user needs to specify the age of the building (in years), the surface in m^2 and distribute the percentage of its use between different available products of the farm.

The third tab of the module is devoted to the materials (Figure 25).



	Age	Quantity	Unit	Product 1	Product 2	Product 3	Product 4	Product 5
				dcattle	cereal	none	none	none
Concrete area	1	100	m2	100 %	%	%	%	%
Concrete area	0	0	m2	%	%	%	%	%
Cement	0	0	kg	%	%	%	%	%
Cement	0	0	kg	%	%	%	%	%
Concrete	0	0	m3	%	%	%	%	%
Concrete	0	0	m3	%	%	%	%	%
Steel	0	0	kg	%	%	%	%	%
Steel	0	0	kg	%	%	%	%	%
Agricultural plastics	0	0	kg	%	%	%	%	%
Agricultural plastics	0	0	kg	%	%	%	%	%
Aluminium	0	0	kg	%	%	%	%	%
Aluminium	0	0	kg	%	%	%	%	%
Alloy	0	0	kg	%	%	%	%	%
Alloy	0	0	kg	%	%	%	%	%
Stainless steel	0	0	kg	%	%	%	%	%
Stainless steel	0	0	kg	%	%	%	%	%
Glass	0	0	kg	%	%	%	%	%
Glass	0	0	kg	%	%	%	%	%

Figure 25: Materials

The user has the possibility to describe specific materials (with a lifetime of several years) used on the farm, such as concrete area, cement, concrete, steel and agricultural plastics.

For each material, the user has to specify the age (in years), the amount (specific unit per category) and distribute the percentage of use of this input between the different available products of the farm.

The user must be careful to take into account the specific unit (m^2, kg or cubic metres) for each category.

2.3.4 Organic matter flows

Figure 26 is devoted to imported and exported organic matter (e.g. manure, straw or compost) at the farm level. These flows have consequences on the nitrogen balance of the farm. That is why the user has to pay attention to this module.

Those holdings that either import of export organic material should indicate the quantities here. For instance, if all manure produced at a farm is not spread on the fields of that farm, the quantities of manure that are used at other farms or treated as waste should be indicated here. Similarly, holdings that import manure from other farms should indicate the quantities in this module.

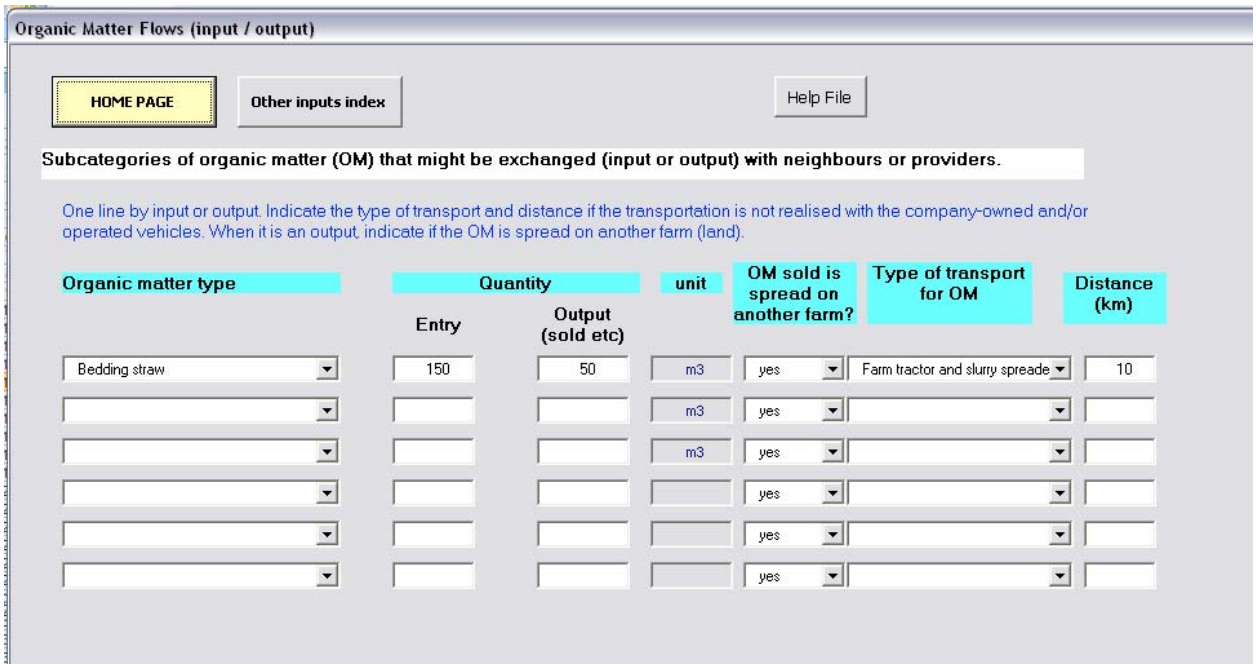


Figure 26: Organic matter flows (input/output)

The user can select the suitable type of organic matter in a pre-defined drop down menu for both imported and/or exported material. This list includes different materials: bedding straw, cattle manure, compost and sewage sludge.

The user has to quantify inputs as well as outputs in accordance to the unit of each organic matter: m^3 or tonnes of product.

When organic matter is an output, the user has to specify if it is spread on fields of another farm or not.

In all cases, if the farmer does not transport the organic matter with his own machinery, emissions due to the transport from/to the provider are included. The user has to choose the type of transport and the distance.

2.3.5 Secondary inputs

Figure 27 is devoted to secondary inputs (annual use).

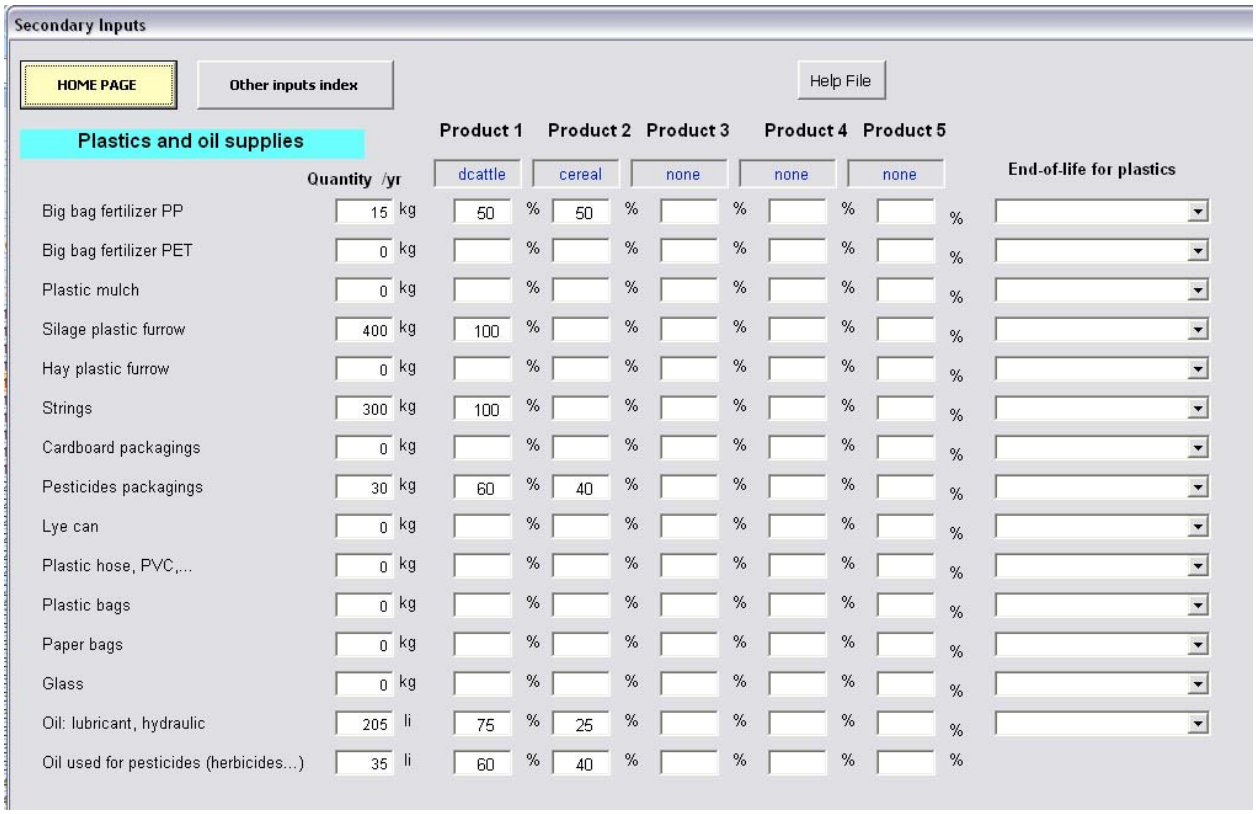


Figure 27: Secondary inputs

Secondary inputs include various inputs: fertiliser big bags, plastic mulch, cardboard packaging, glass, etc. The user has to indicate the annual use of each input, making sure to respect the unit that varies according to the inputs.

Finally, the user distributes the percentage of use of the different inputs between the available products of the farm.

2.3.6 Machinery

This module is split into three different tabs: tractors and transportation, field operations and livestock materials and others (

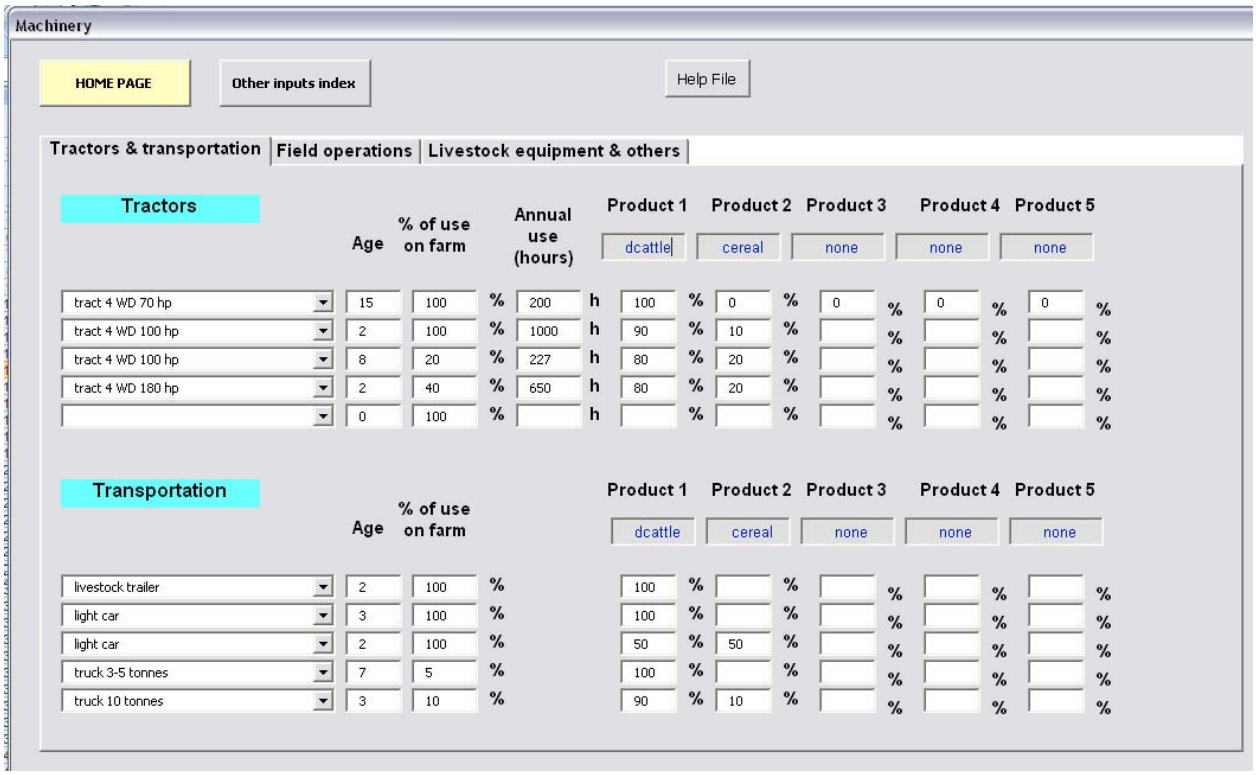


Figure 28).

In all, there are 12 categories of equipment. For each category, the user can select the suitable equipment corresponding to the farm from a drop down menu.

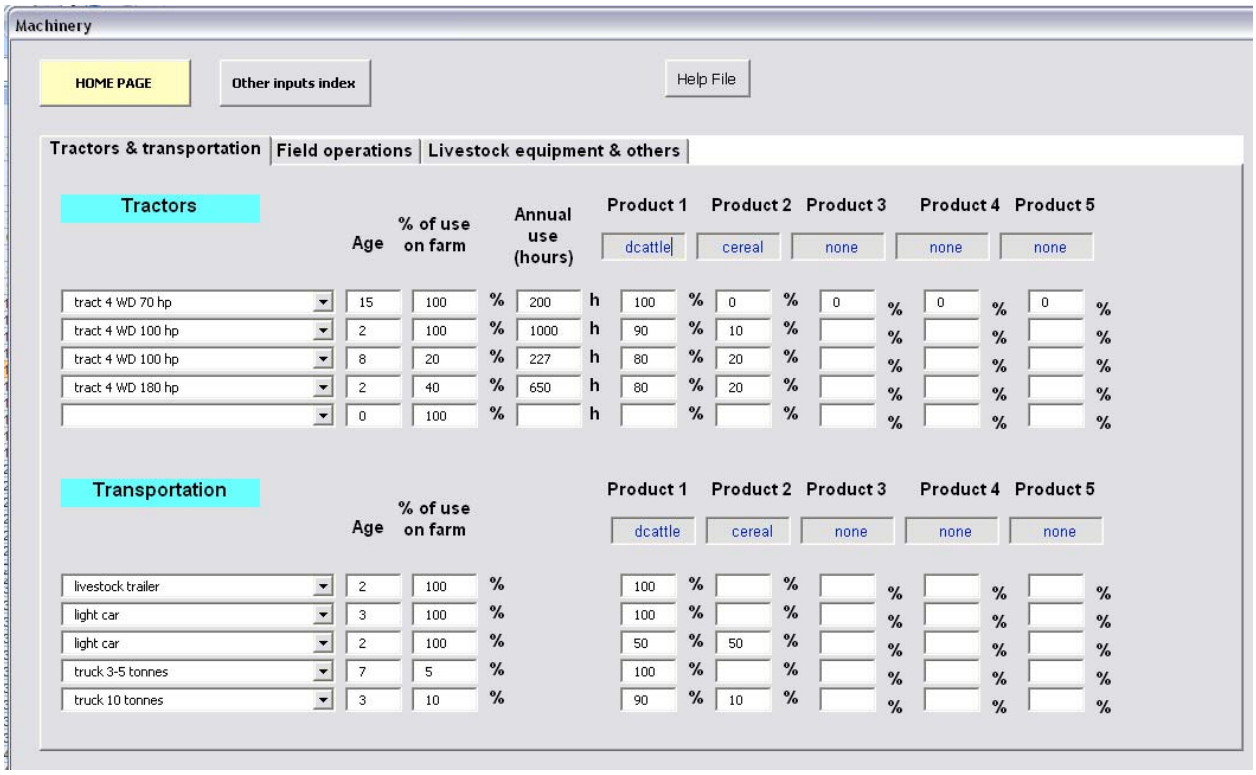


Figure 28: Tractors and transportation

For all equipment in the tractors and transportation category, the user has to indicate the age (in years), the percentage of use of the equipment in relation to its total use (including outside of the farm) and distribute the percentage of use of this equipment between the different available products of the farm.

For tractors, the user can fill in optional data corresponding to the number of hours/year.

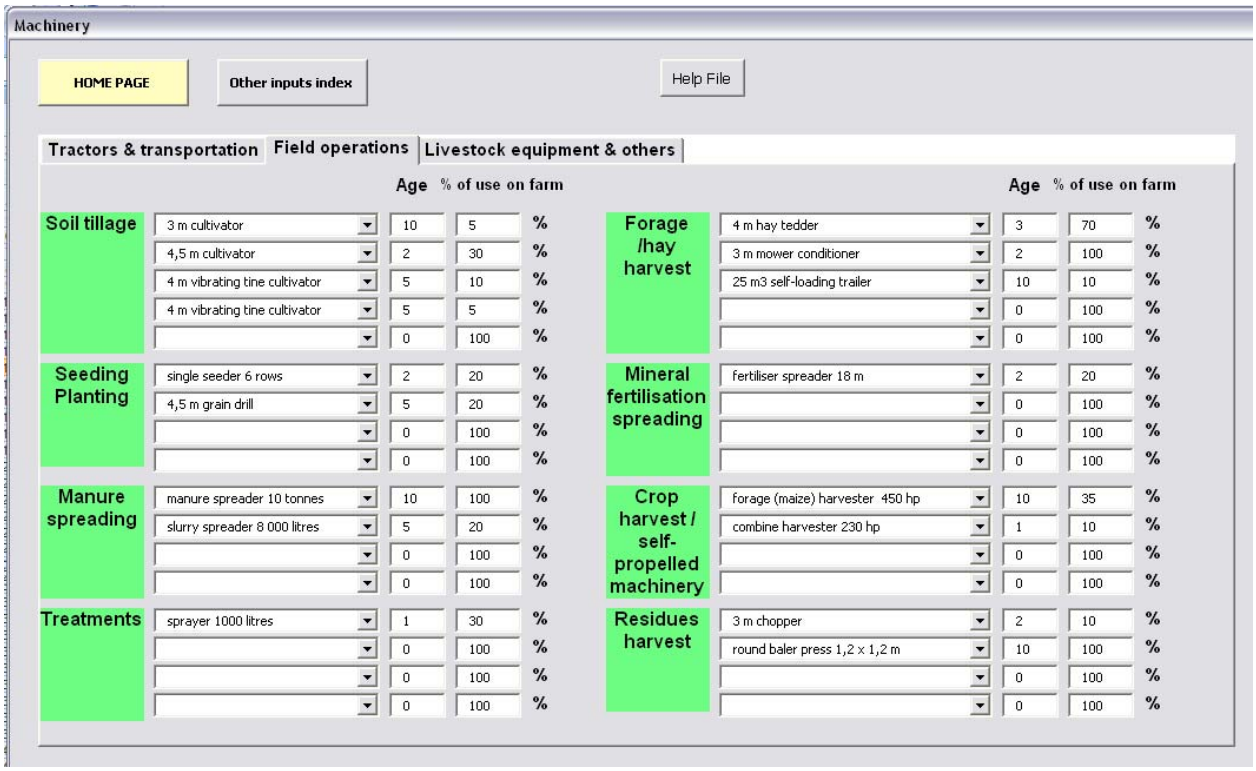


Figure 29: Field operations

Once the suitable equipment in the field operations category has been selected from the drop down menu, the user has to fill in the age (in years) and the percentage of use of the equipment in relation to its total use (including outside the farm).

For field operations, there is no allocation between products expected from the user as it is done automatically based on the data given in the cropland module (Figure 29).

Figure 30: Livestock equipment and others

Once the suitable equipment in the livestock materials and others category has been selected from the drop down menu, the user has to fill in the age (in years), the percentage of use of the equipment in relation to its total use (including outside the farm) and distribute the percentage of use of this equipment between the different available products of the farm (Figure 30).

2.3.7 Cooling, refrigerant and air conditioning systems

In this part, emissions taken into account by the Carbon Calculator are those from direct activities. Only equipment owned by the farm are considered.

This module requires some specific data about hydrofluorocarbon (HFC) gases possibly used on the farm, especially:

- For milk tanks,
- For the air conditioning of tractors, cars and other self-propelled machinery,
- For the refrigeration of cold chambers, of retail installations owned by the farm or directly managed by the farmer.

The user can click on different pages for the different types of cooling and refrigeration systems.

Data needed are: equipment or power capacity by type of equipment and type of HFC gases in the systems. If the user does not know the type of gases, the 'unknown' option should be selected.

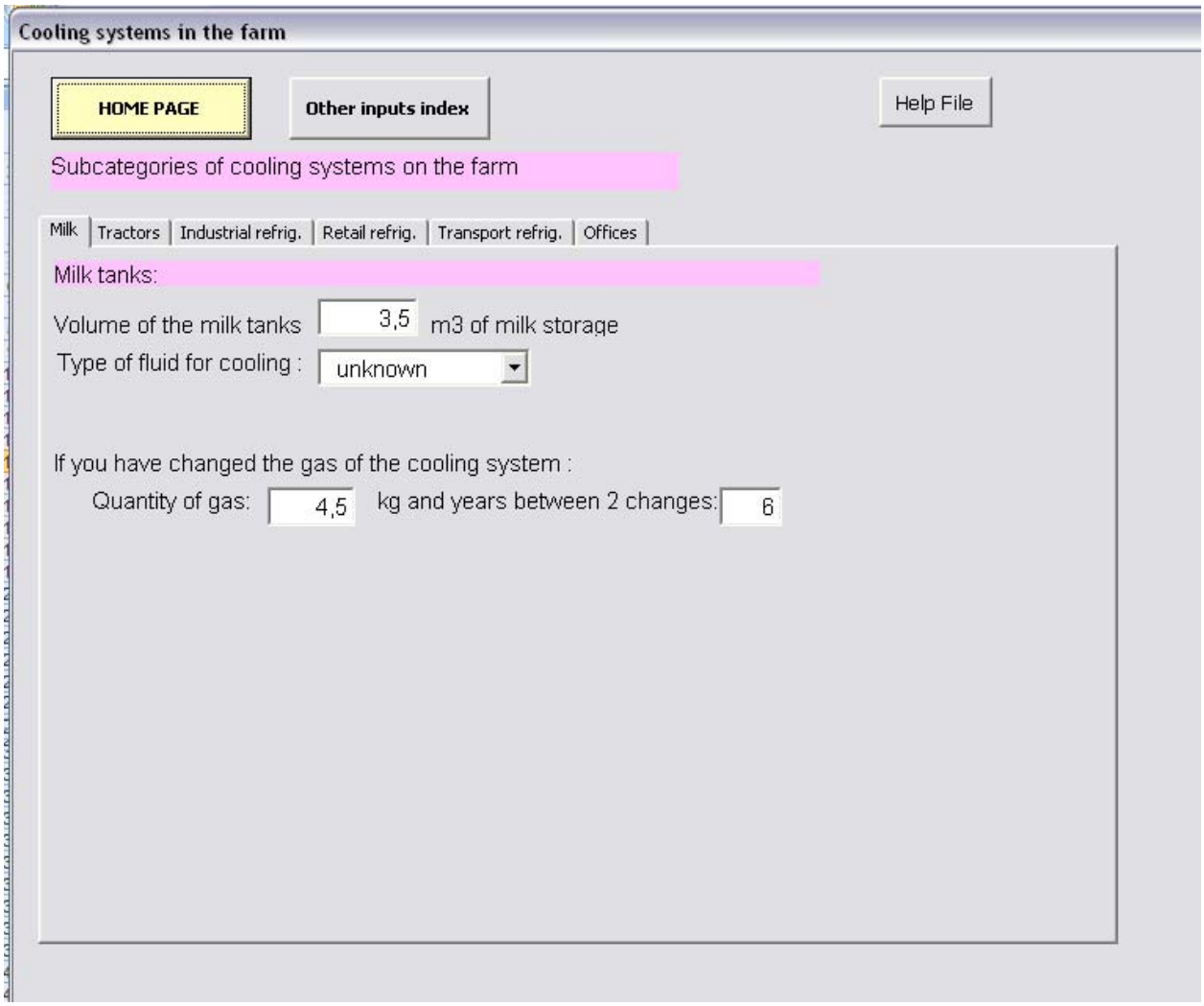


Figure 31: Cooling systems in the farm

2.4 Livestock

2.4.1 Livestock selection

In the livestock module, the first step for the user is to select the suitable livestock from the following list: dairy cattle, meat cattle, goats, dairy sheep, meat sheep, other ruminants, pigs, laying hens and poultry (Figure 32).

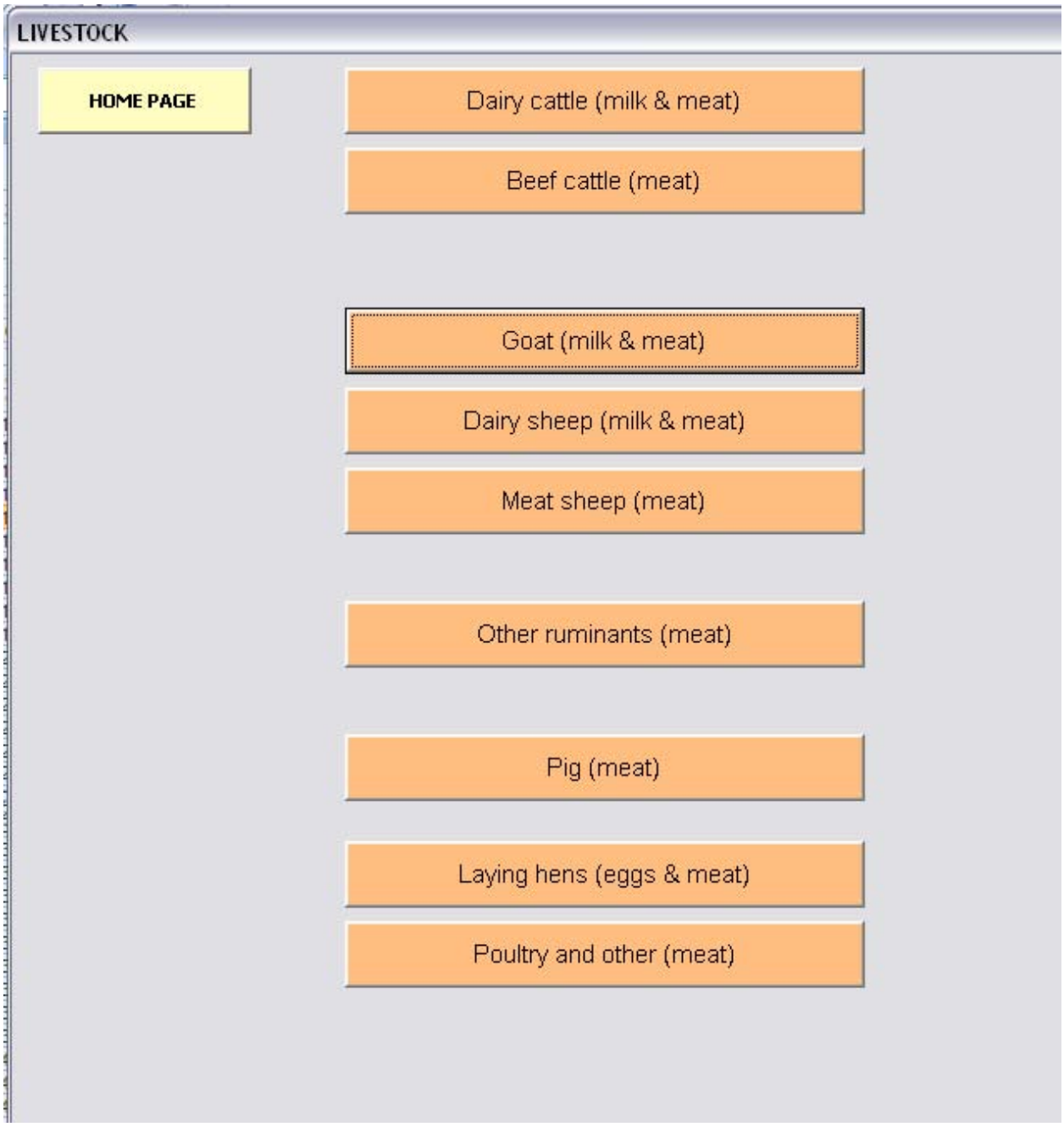


Figure 32: Livestock index

Then, the user has to describe livestock management practices in subsequent forms (livestock description, forage intake, feedstuffs intake and manure management systems).

The example in this manual is based on a “Dairy cattle” livestock.

2.4.2 Livestock description

The aim of the first tab of the livestock module is to describe the livestock (Figure 33).

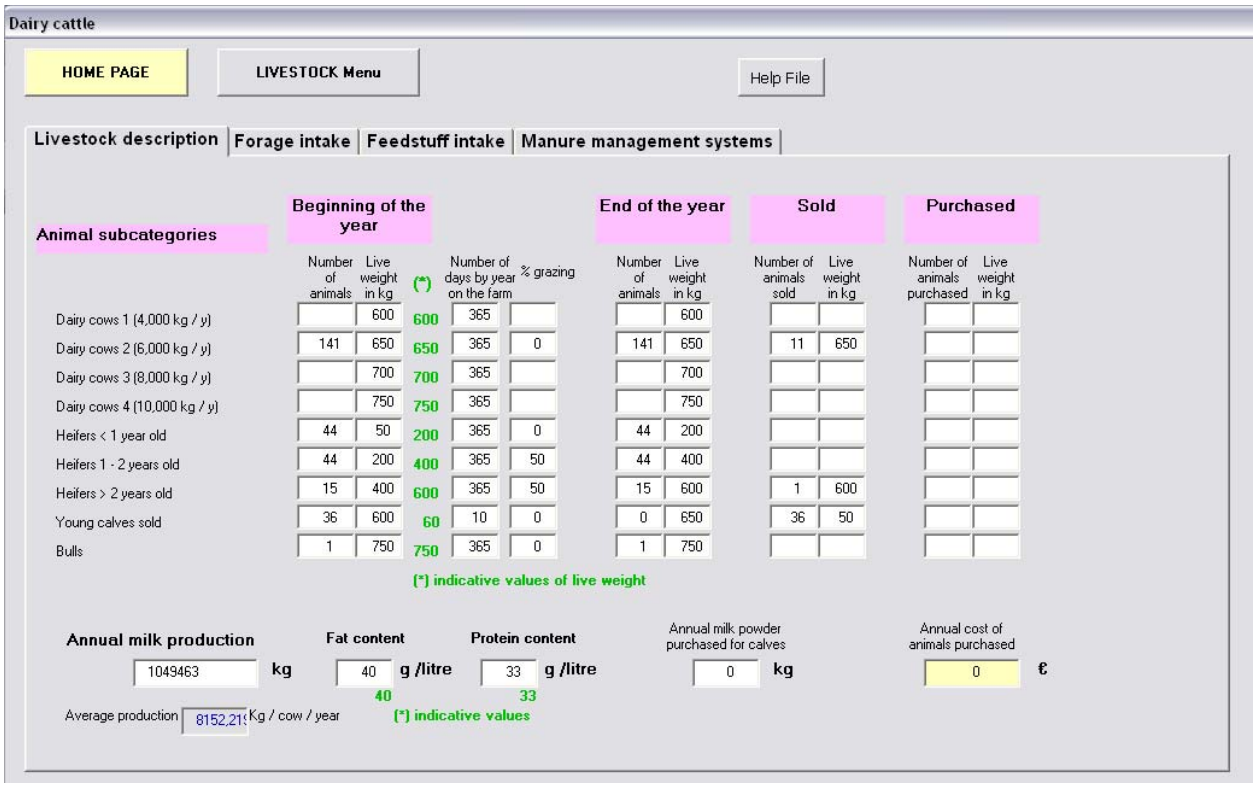


Figure 33: Livestock description

The subcategories of animals are pre-defined for each category of livestock.

An annual inventory is required for these sub-categories of animals that correspond to the number of animals at the beginning and at the end of the year, the number of animals sold and purchased during the year of reference. In addition to the number of animals, the live weight in kg of the animal for each sub-category is always required.

Depending on the livestock categories, the user sometimes has to indicate the production quantity in the bottom of Figure 33. For example, in case of dairy cows the total milk production in kg per year including fat content and protein content is needed.

Also, the user can fill in the amount (in kg) of milk powder purchased and the annual cost for the animals purchased.

Some additional information:

For Pigs:

Subcategories of pigs are associated with a type of diet and particularly with the protein contents in their diet. For each subcategory, the user has to choose between:

- “1 type of protein” when there is no adaptation of the protein content in the diet based on the age of the pig;
- “2 types of protein” when the protein content in the diet is adapted to the needs which evolve with age.

For hens and poultry:

Subcategories of hens and poultry are described with subtitles, which indicate type of husbandry practices:

CERTIFIED: the product is certified: the husbandry practices comply with technical specifications and are controlled by a certifying body.

ORGANIC: organic production of poultry

GROUND: hens are raised on the ground

INDUS: type of broiler

LIGHT / EXPORT / HEAVY: type of poultry depends on the market

FREE RANGE: animals are in free-range

PEN: for hens

2.4.3 Forage intake

The aim of the second tab of the livestock module is to describe the forage intake (Figure 34).

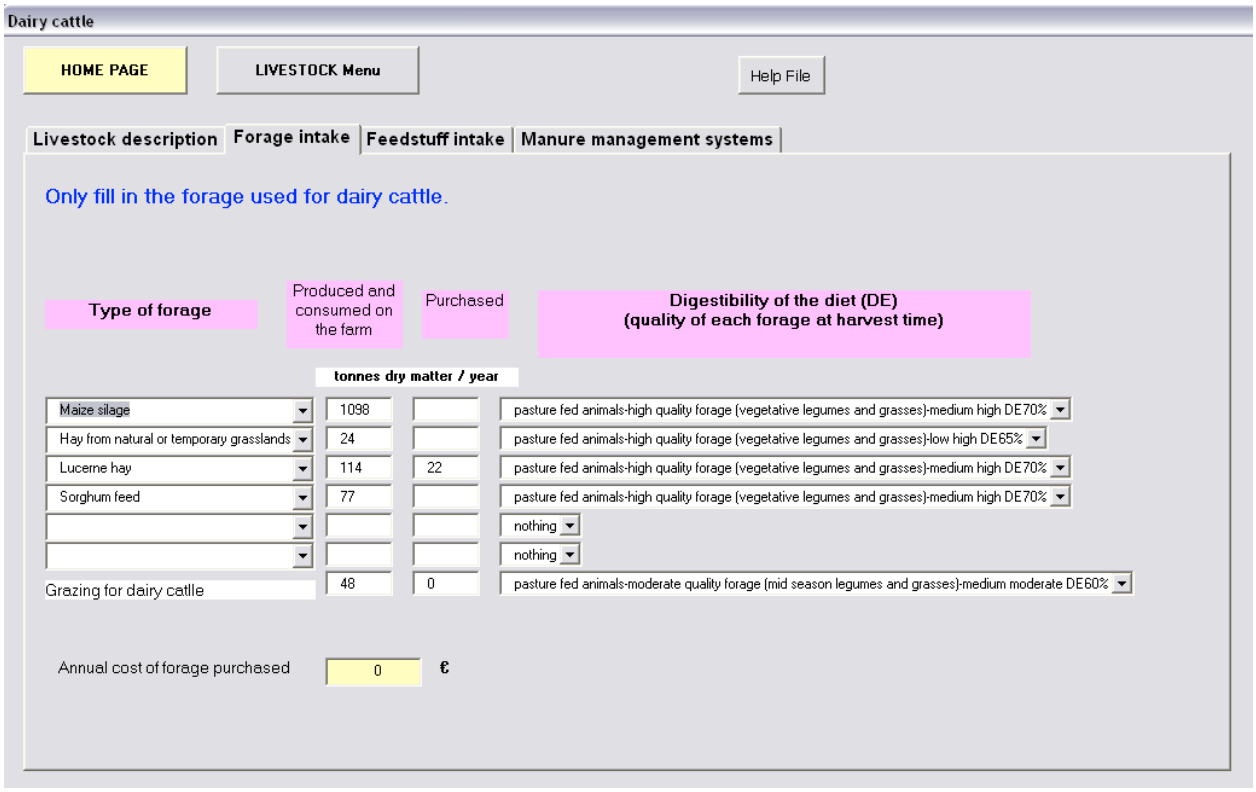


Figure 34: Forage intake

The user shall select the suitable forage consumed per livestock (with a maximum of six different forages) from a pre-defined drop down menu.

Then, the user shall indicate (in tonnes of dry matter) the annual consumption of both intra-consumed forage (produced and consumed on the farm) and purchased forage for the livestock category. A tonne of forage (produced or purchased) is needed as a minimum in the Carbon Calculator when the livestock description is filled in.

The last information concerns the digestibility of the diet; the user has to select the suitable information related to each fodder in a drop down menu. The digestibility of the diet corresponds to the mean quality of each fodder at harvest time. A tonne of feedstuff (produced or purchased) is needed as a minimum in the Carbon Calculator when the livestock description is filled in.

Finally, the user has the possibility to fill in the annual cost of forage purchased.

Note that straw in this section is for livestock feed. Straw for litter is an organic matter input (see section “Organic matter inputs/outputs”).

2.4.4 Feedstuffs intake

The aim of the third tab of the livestock module is to describe the feedstuffs intake (Figure 35).

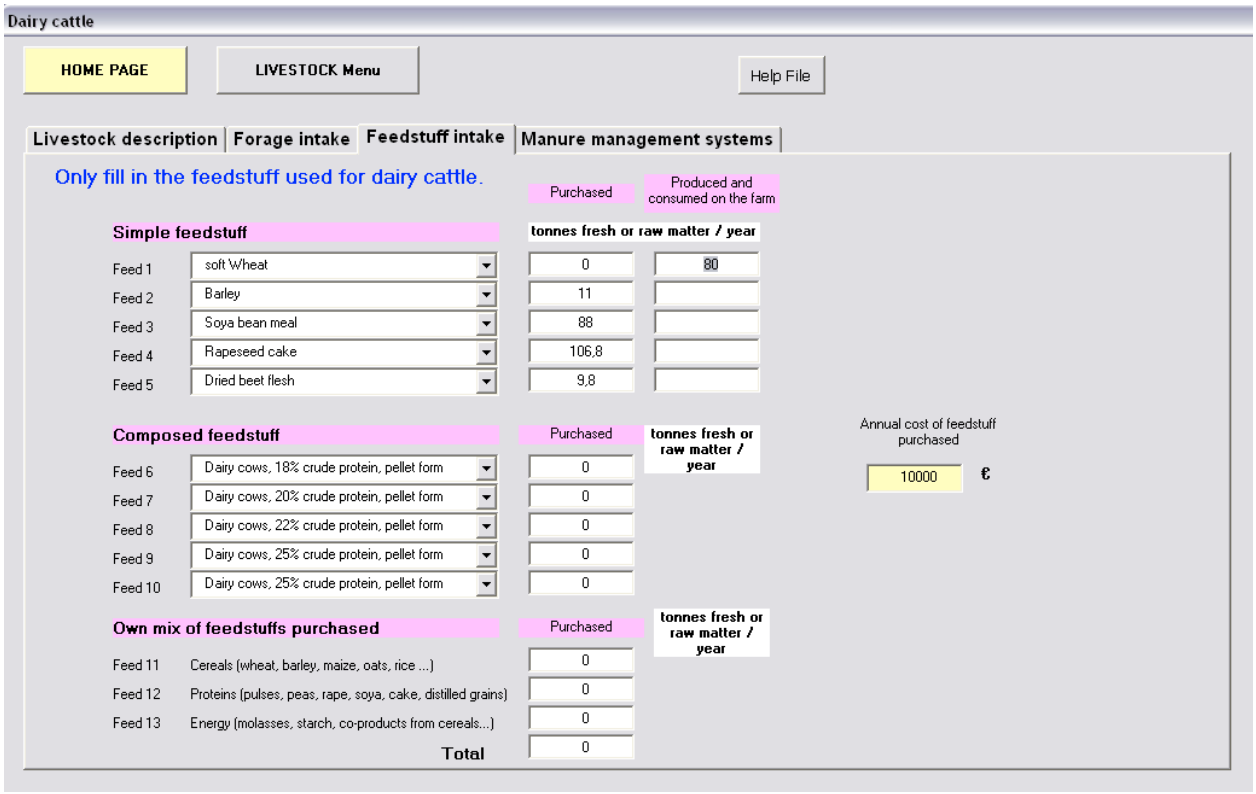


Figure 35: Feedstuff intake

Feedstuffs are divided among simple and composed forms. For composed feedstuffs, the user has two options: use a predefined “composed feedstuffs” based on the crude protein content or compose their own mix of feedstuffs purchased based on the total amount of cereals, protein crops and energy feed.

For simple feedstuffs, the user has to quantify (in tonnes of fresh matter) the annual consumption of both intra-consumed and purchased feedstuffs for the livestock category. It is important to pay attention to the origin of the feedstuffs: intra-consumed (intra-consumed means that the cereals are produced and consumed on the farm) or purchased.

Finally, the user can fill in the annual cost for feedstuffs purchased.

2.4.5 Manure management systems

The aim of the fourth tab of the livestock module is to describe the manure management systems (Figure 36).

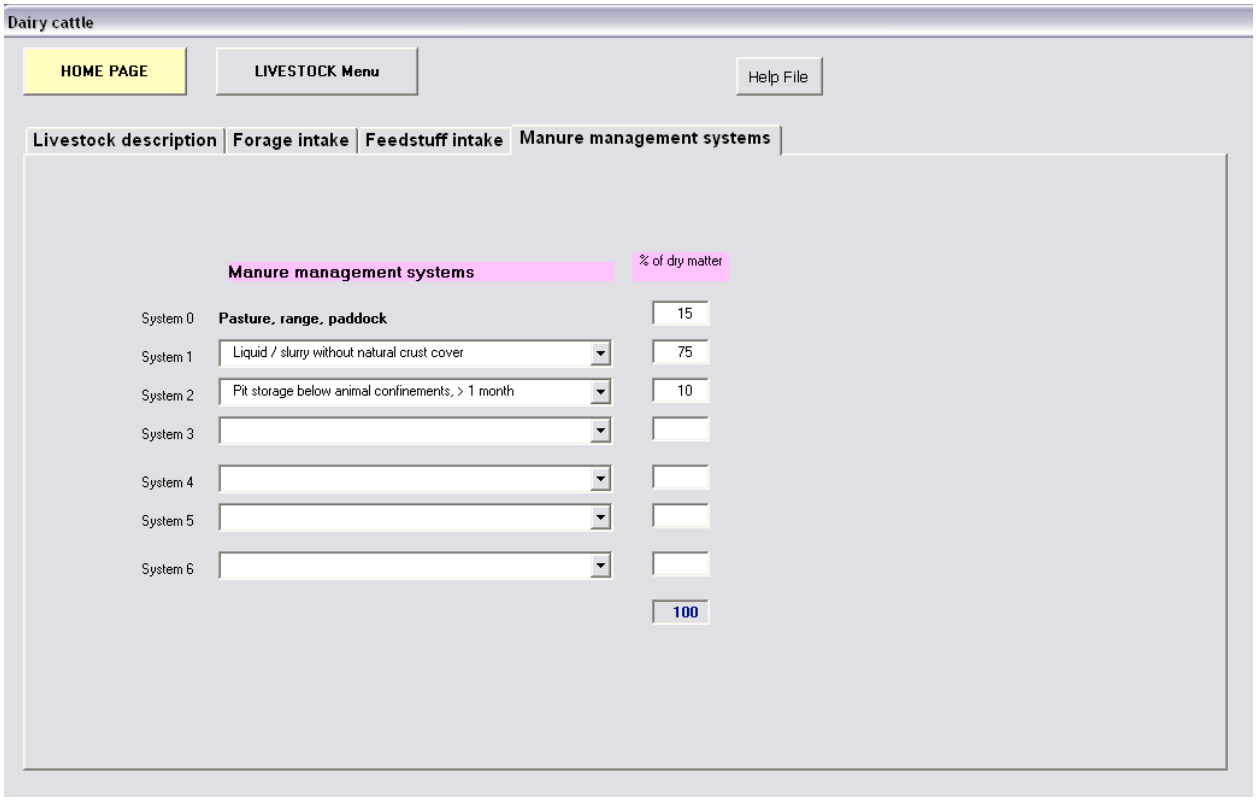


Figure 36: Manure management systems

A pre-defined list of manure management systems is available for the user in a drop down menu. The user has the possibility to select several manure management systems, including pasture, to one livestock category.

The "% of dry matter" is the distribution of total dry matter between the different manure management systems. That data can be estimated based on the time spent on distribution if there is no other analysis.

The user has to pay attention that the total amount of the manure management systems matches 100%.

2.5 Cropland

2.5.1 Crop index

When the user clicks on the cropland button, the first form is the crop index.

The top buttons lead to other forms: add a crop, delete a crop or modify a crop, and go to the home page.

On the top right hand side, the consistency of the UAA of the farm and the aggregate area of all crops listed in the left hand side is checked. If there is a difference between these two areas, a message box alerts the user. He/she can validate that difference or correct it with the “modify a crop” button.

On the right hand side, a table presents aggregated fertiliser purchases in tonnes by year, calculated with the fertilisers used for each crop. Below, the user is invited to add annual costs for fertilisers and for pesticides. The Carbon Calculator has converted all the mineral fertilisers into amount of each physical form, taking into account the content of each mineral component. For example, 335 kg of nitrogen from ammonium nitrate correspond to a tonne of ammonium nitrate.

Thus, the user can check the consistency between the annual amount from the fertiliser invoices and the spreading per crop.

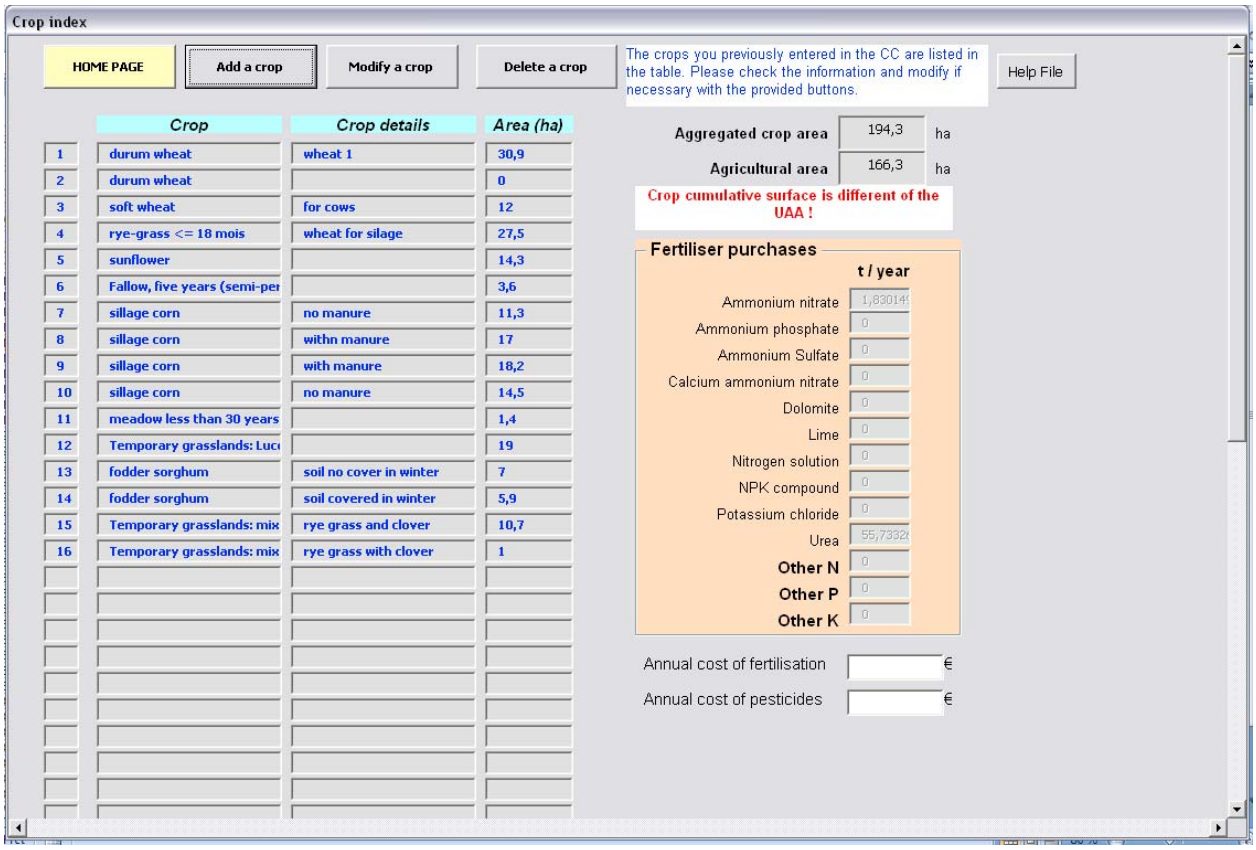


Figure 37: Crop index

In the croplands module, the first step for the user is to select a crop by clicking on the “Add a crop” button (see Figure 37).

Then, the user has to choose from the pre-defined crop list (Figure 38). This crop list gathers cereals and forage as well as vineyards and orchards, vegetables or industrial crops. First they have to select the type of crop and secondly they shall choose one crop in the list. They can select the same crop several times and customise it. It is therefore recommended that the user divide a crop into several sub-crops depending on crop management practices. This separation may simplify the work of data input.

The user can create a maximum of 50 crops in the Carbon Calculator.

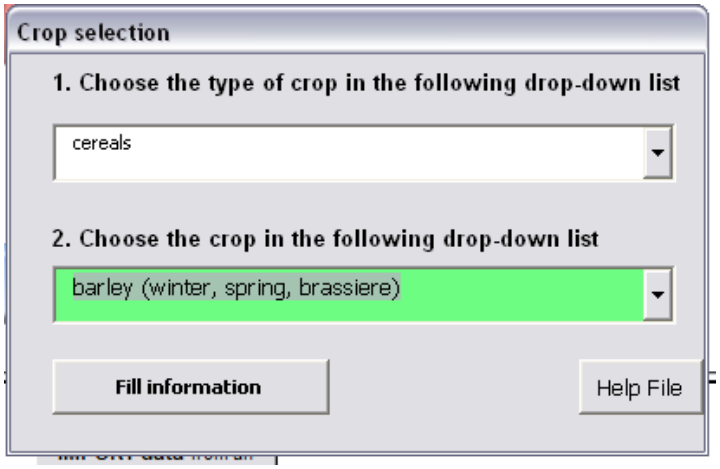


Figure 38: Crop selection

Once the crop has been selected, the user has to describe crop management practices in a subsequent form (fertilisation, pesticides, cropland management, machinery and irrigation).

2.5.2 General data for crops

As illustrated in Figure 39, a fixed area is always visible on top of the screen. The user shall indicate the area (in ha) and the yield by ha (paying attention to the unit indicated in the right side) with minimum and maximum yields.

Moreover, the user has the possibility to customize the name of the crop in the “crop details” zone, for example: organic, practices 1, wheat for dairy cattle, etc.

Finally, the user shall specify if the crop is cultivated on organic soils or not.

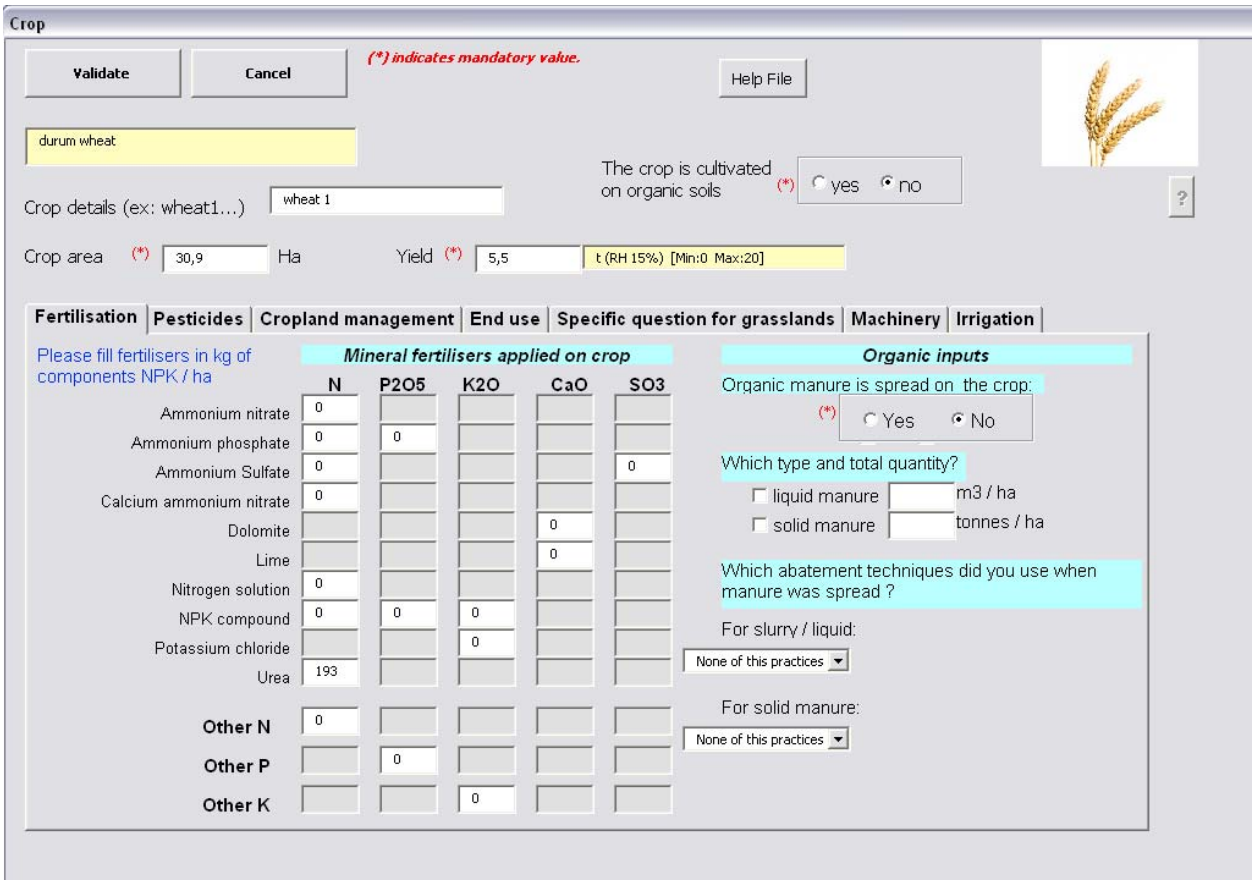


Figure 39: General data

2.5.3 Fertilisation

The aim of the first tab of the cropland module is to describe the fertilisation of the crop (Figure 40).

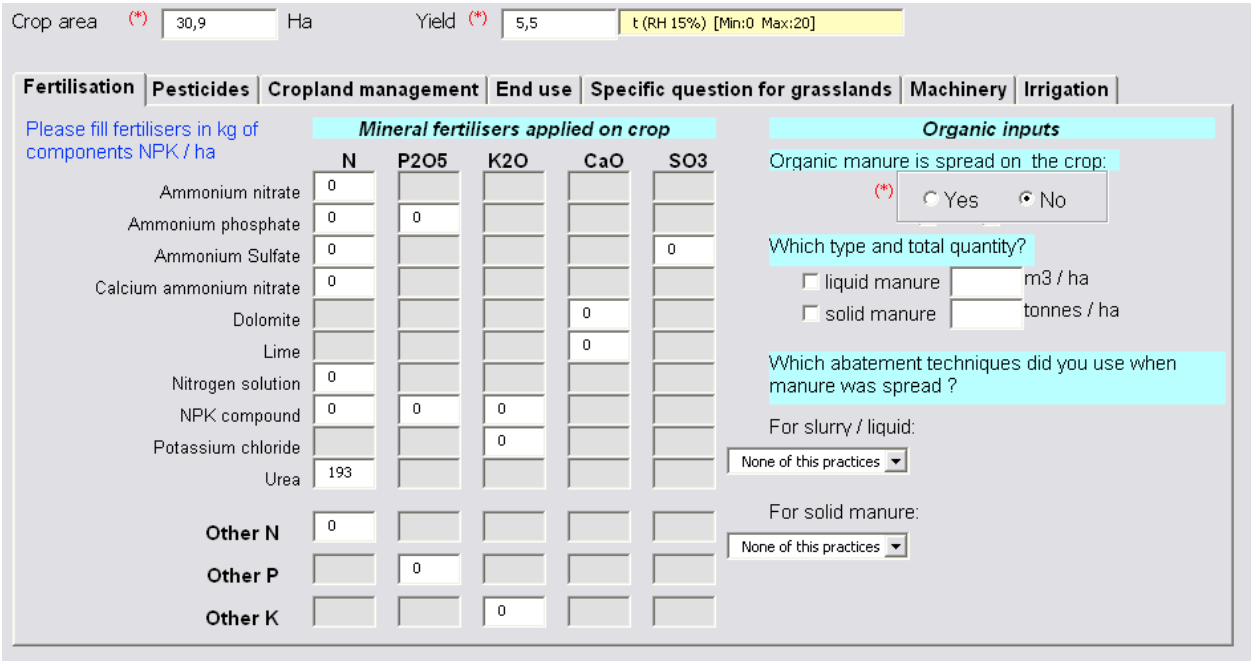


Figure 40: Fertilisation information

In the left part of the table (Figure 40), the user has to describe mineral fertilisation using kg of components (mineral elements) per ha for a fixed list of 10 different mineral fertilisers. If the user cannot find the component used on the farm in that list, he/she can fill in the general nitrogen, phosphorus and potassium fields. The amounts of each fertiliser should be given in kg of nitrogen (N), phosphorus (P_2O_5), potassium (K_2O), lime (CaO) or sulfur (SO_3).

The Carbon Calculator multiplies these amounts with the area of each crop to calculate the total amount of each fertiliser, shown in the “Cropland” module.

Only the white cells should be completed. Blank cells are not accepted: “zero” values are shown as default.

Also, the user can describe the organic fertilisation of the crop by selecting the right answer on the right side of Figure 40. In case of organic manure, the user can specify the form (liquid or solid), the quantity that is spread on the area (in cubic metres or tonnes by ha) and the type of spreading machinery used for the slurry and for the solid manure. This last information targets the definition of abatement techniques for reducing ammonia emissions during spreading.

2.5.4 Pesticides

The second tab of the cropland module is devoted to pesticide management (Figure 41).

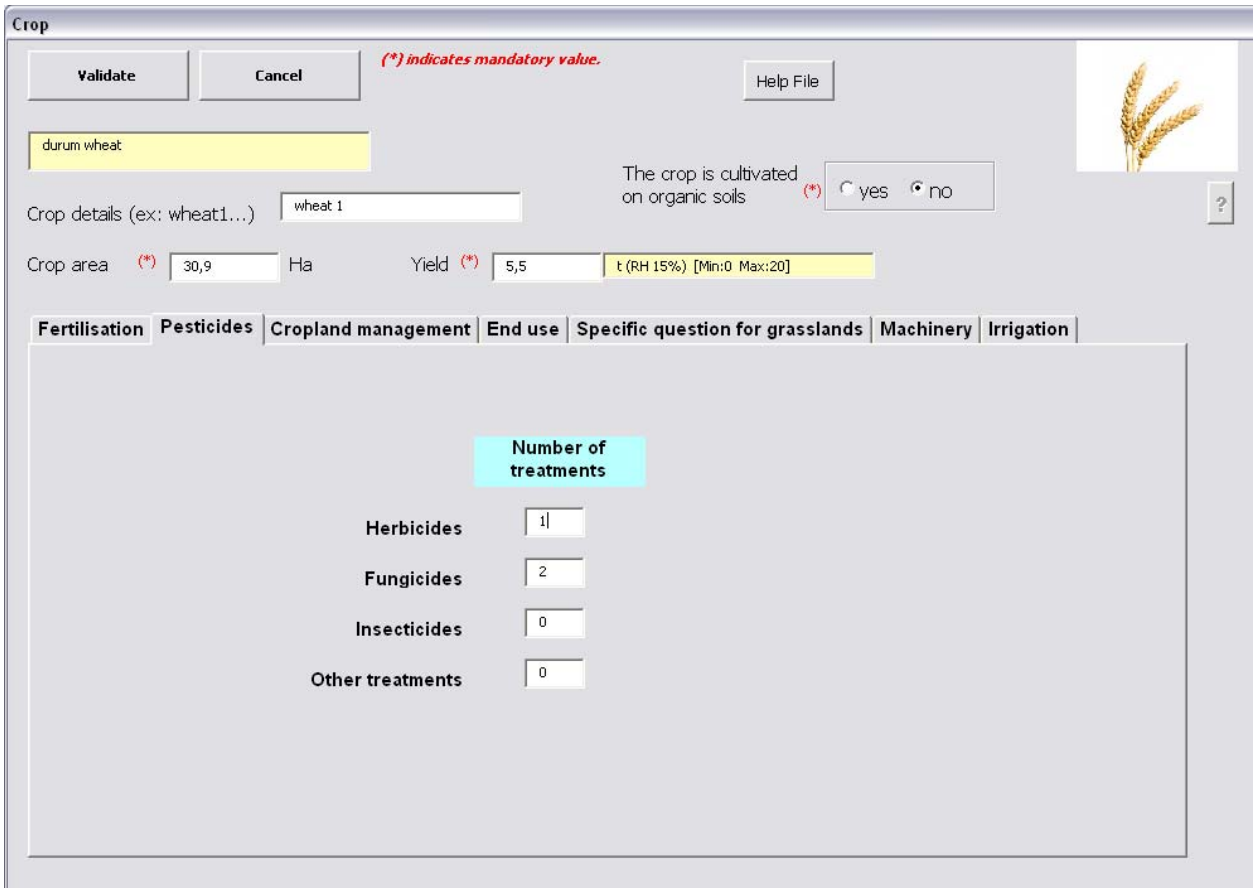


Figure 41: Pesticide treatments

The user has to specify the number of treatments per crop depending on the pesticide categories that are herbicides, fungicides, insecticides and other treatments.

A default value of active matter per treatment has been implemented in the Carbon Calculator for each pesticide category.

2.5.5 Cropland management

The third tab of the cropland module is devoted to cropland management (Figure 42).

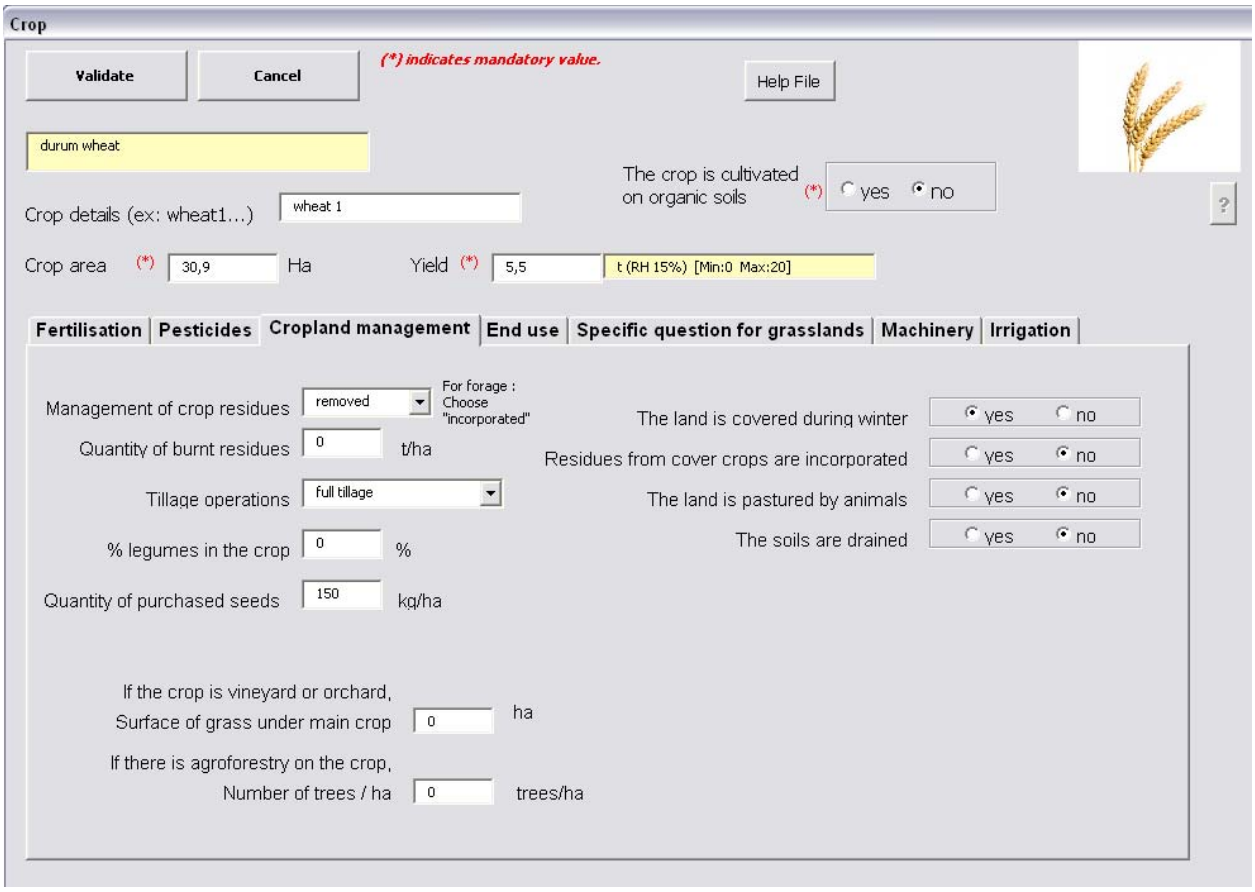


Figure 42: Cropland management

On the left side of Figure 42, the user shall specify:

- How crop residues are managed: burnt, exported from the field or incorporated into the soil.
- The quantity of burnt residues in tonnes of dry matter per ha (only if it is concerned).
- Tillage operations: full tillage, reduced tillage or ploughing.
- The % of legume in the crop: in case of lupine, soya, spring or winter field bean, chick pea, lentil crop, the user has to implement 100% as well as in the case of temporary grasslands of legumes such as Lucerne, red clover, white clover, vetch, etc.). If legumes are mixed with non-legume species, then the user has to clarify the exact % of legumes.
- Seed quantity in kg/ha: this information is required only if the seeds are purchased.
- Surface of grass under vineyards and orchards (where relevant).
- Number of trees per ha: this information is required only when there is agroforestry on the crop.

On the right side of Figure 42, the user shall select 'Yes' or 'No' to:

- The land is covered during winter: the user must take into account the crop type (for example winter or spring barley) as well as the implementation or not of cover crop during winter.
- Residues from cover crops are incorporated into the soil: the user shall select 'Yes' only in this case.
- Is the land pastured? If animals are pasturing the land, no matter how long, the user has to select 'Yes'.
- Are the soils drained: if the soils are drained, then the user shall select 'Yes'.

2.5.6 End use

The fourth tab of the cropland module is devoted to the end use of the products (Figure 43).

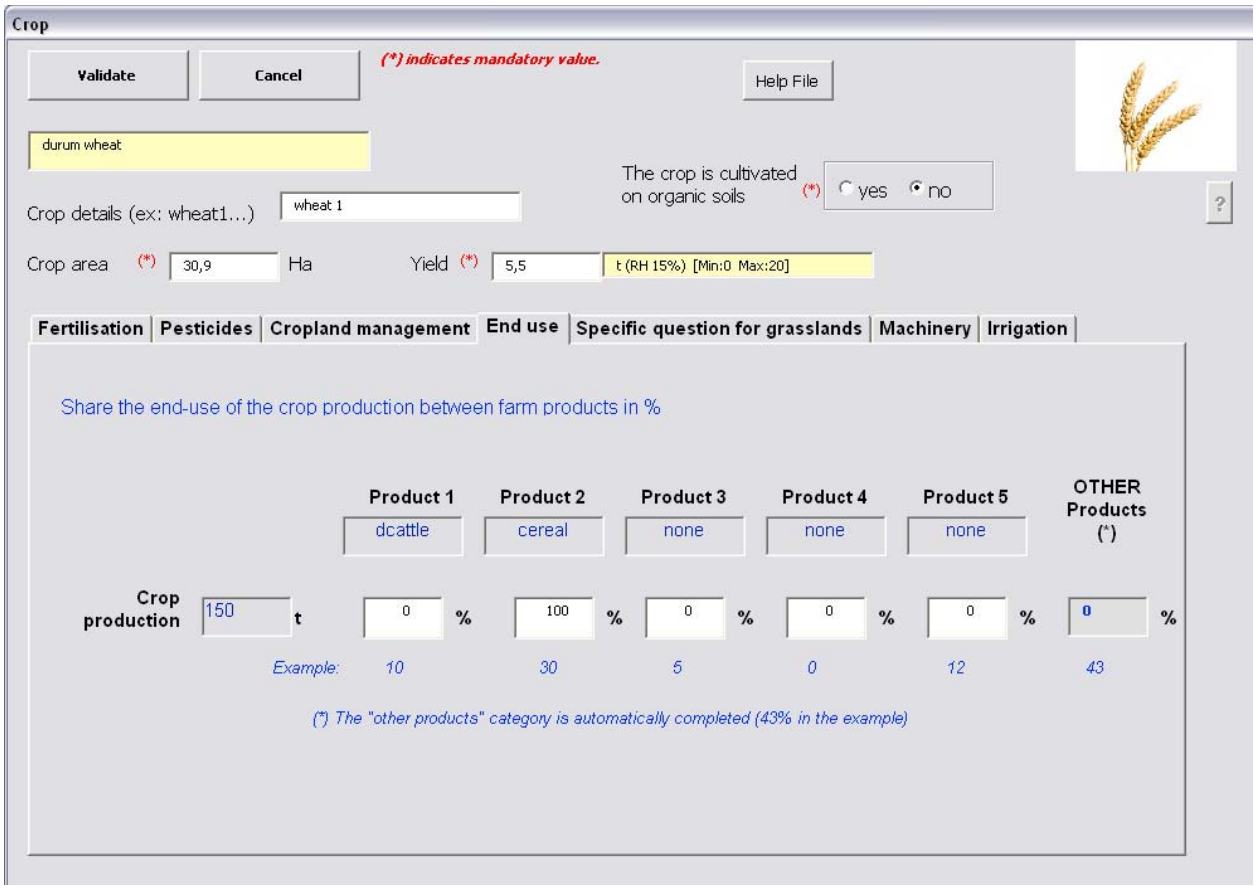


Figure 43: End use of the products

The user has to distribute a crop production to one or several products of the farm depending on the end-use of the crop production. The “other products” share is automatically calculated as the difference to 100%.

Example:

For instance, in the case of a durum wheat crop on a farm with dairy cattle and cereals, the user allocates the use of the crop between the products selected in the Assessment identification, e.g. 0% for feeding and 100% sold (cereals product).

2.5.7 Specific questions for grasslands

The fifth tab of the cropland module is exclusively devoted to grasslands (Figure 44). These questions are only related to grasslands that are over five years old, and need not be completed for temporary grasslands that have been ploughed less than five years ago.

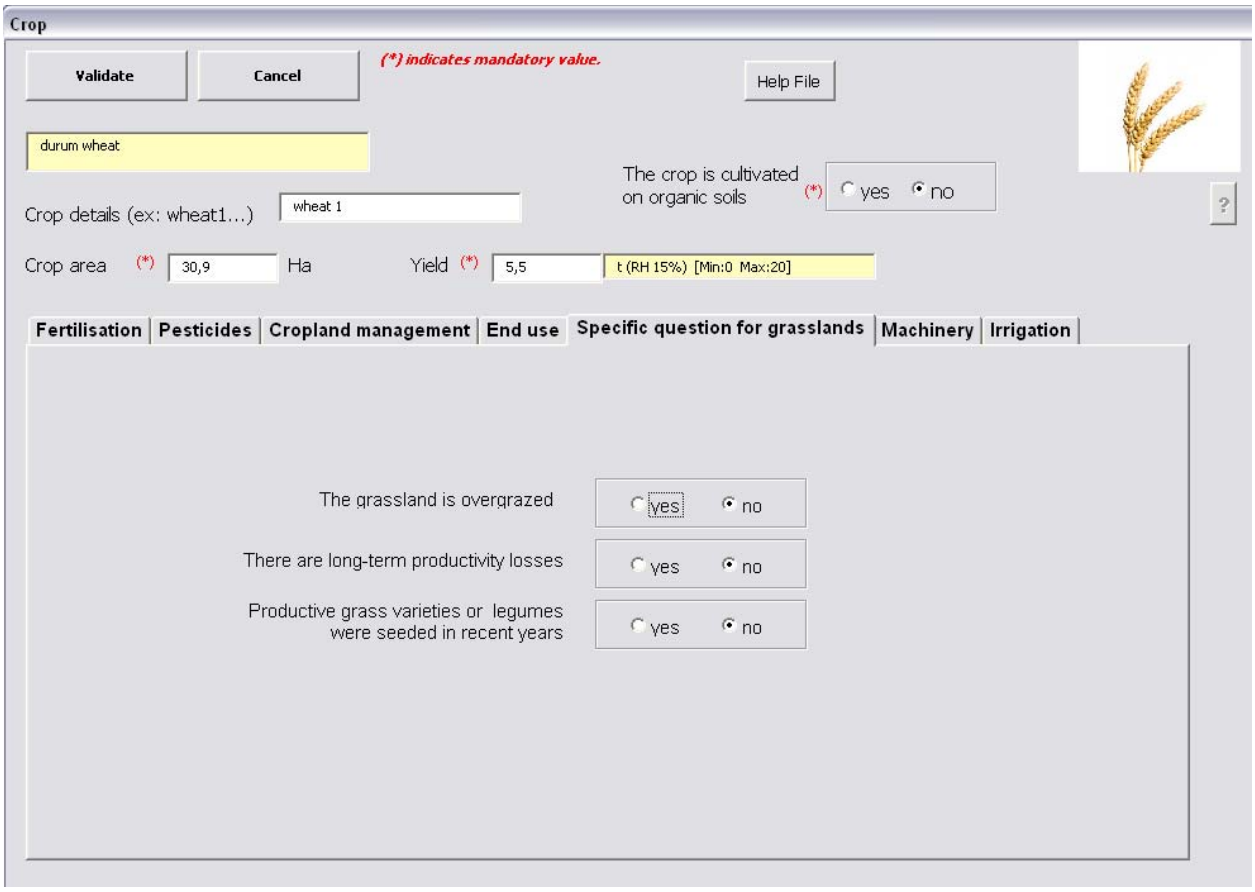


Figure 44: Questions related to grasslands

In case of grasslands, the user has to select the suitable answers to the three following questions:

- Is the grassland overgrazed?
- Is there a long-term productivity loss?
- Were productive grass varieties or legumes seeded in recent years?

Overgrazing:

Overgrazing may be the result of excessive loading of livestock or of insufficient rest time for the grass (especially in autumn). Grasses build energy reserves in their roots and at the basis of their stems. Thus, overgrazing systematically leads to a more or less pronounced degradation of the grassland, as these reserves are important for the grass to regrow when weather conditions are favourable. It is recommended to keep a grass height between five and six cm in late season to avoid prejudicing the spring regrowth. Overgrazed grassland can take three to five times longer to regrow with a dry matter production generally twice lower.

Thus, overgrazed grassland is characterised by a low density of grasses, longer time to regrow and a loss of productivity. These characteristics can help the user qualify overgrazing.

Loss of productivity:

If the loss of productivity is recurrent in recent years, then the user has to select “Yes”. If it is the first year that overgrazing is observed, then the user has to tick “No”.

2.5.8 Machinery

The sixth tab of the cropland module is devoted to machinery and fuel to cultivate the crop (Figure 45).

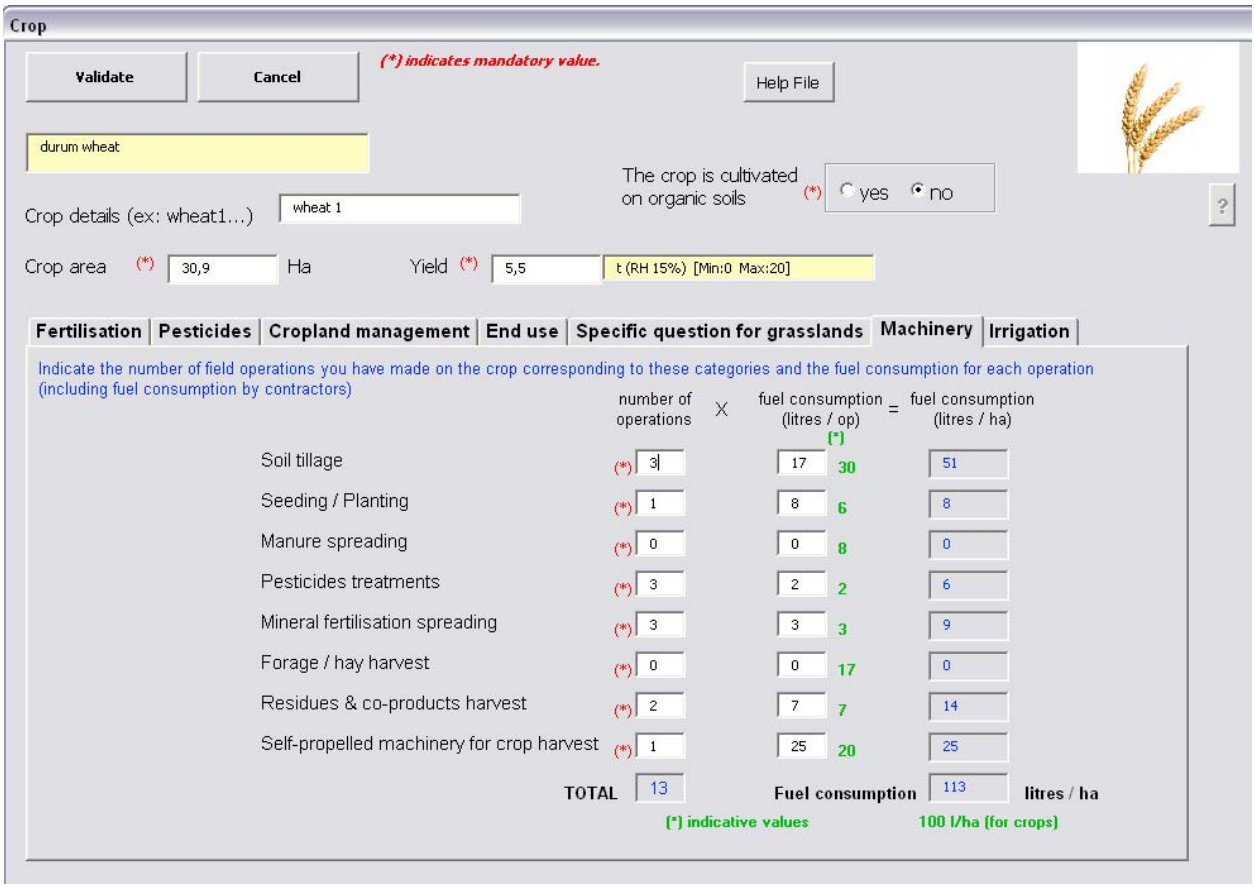


Figure 45: Machinery

The user has to indicate the number of field operations and the fuel consumption by operation, depending of the following categories: soil tillage, seeding/planting, manure spreading, pesticide treatments, mineral fertilisation spreading, forage/hay harvest, residues and co-products harvest, self-propelled machinery for crop harvest. This fuel consumption corresponds to both the farm and to consumption by third parties (in the case of external assistance, contractor, other farmer, etc.).

The tool calculates fuel consumption by ha and type of operation and then, the total fuel consumption in litres per ha.

2.5.9 Irrigation

The last tab of the cropland module is devoted to irrigation management (Figure 46).

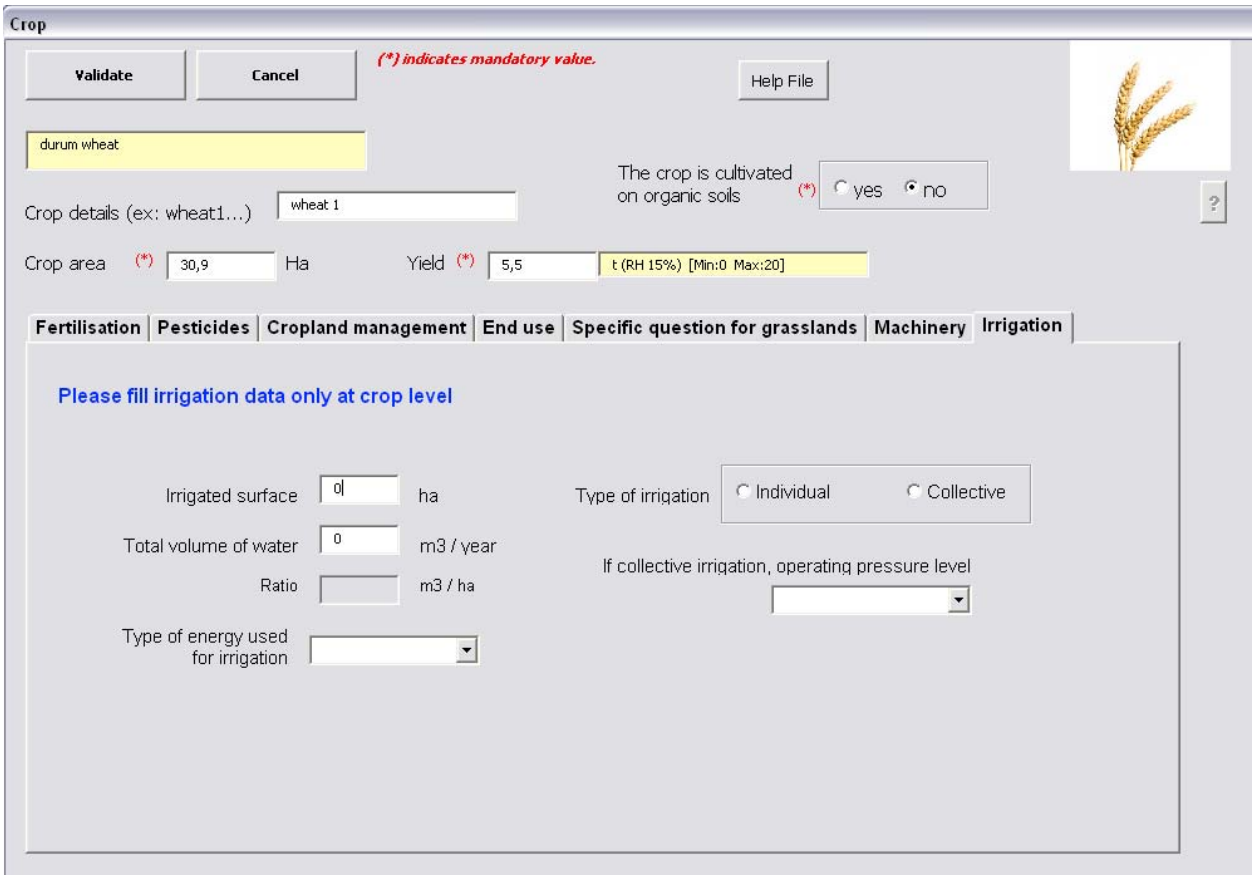


Figure 46: Irrigation management

If there is no irrigation on the farm, the area and volume of water shall be “zero”.

In case of irrigation, the user needs first to specify the irrigated surface and the volume of water used for the crop during a year. The Carbon Calculator indicates the ratio of volume per ha (in m^3/ha). Subsequent information includes the type of energy used for irrigation of that crop (gravity, fuel or electricity) and the type of pumping system for irrigation (collective or individual).

In the case of a collective irrigation pumping system, the user shall specify the operating pressure level. Table 2 can help the user to choose the suitable operating pressure level depending on the type of irrigation system.

Table 2: Type of irrigation

Type of irrigation system	Operating pressure
Gravity irrigation	Not concerned
Hose reel irrigation	High rate sprinkling
Centre pivot irrigation or lateral moved line irrigation or fixed sprinkler system	Medium rate sprinkling
Drip irrigation	Low rate sprinkling

After the validation of data of the crop module, the user comes back to the “cropland” index. He/she can add another crop, modify a crop, or delete one crop.

3 GHG Results

3.1 General

GHG results for the farm are presented in four different formats:

- Total GHG emissions at farm level are expressed in tCO_2e/ha. This presentation includes a graphical comparison to a group and a table with the 5 main sources of emissions at the farm level.
- Total GHG emissions for each of the 5 main products of the farm are illustrated through:
  - tables showing the sources of emissions per product, expressed in tCO_2e/unit including a graphic comparison to a group.
  - a table presenting the 5 top sources of GHG emissions at product scale.
- Total GHG emissions at farm scale for the main gases: CO_2, CH_4, N_2O, HFC and CO_2 from C stock changes.
- GHG emissions saved from mitigation and sequestration actions are reported in a table.

Results presentation for detailed GHG emissions (by sources and gases) is based on the Organisational Environmental Footprint "OEF" guide, with two parts:

- GHG emissions from direct activities (non-mechanical sources, enteric fermentation, manure management, direct and indirect emissions from soils, and burnt crop residues),
- GHG emissions from indirect activities: consumption of purchased electricity and other indirect energy sources like collective irrigation or water pumping, fuel from third parties (contractors, etc.), all other indirect sources linked to manufacturing and transportation (e.g. agrichemical production and product processing).

These detailed results are very useful to analyse different emission sources and help detect the main GHG emission sources of the farm and for on-farm products. GHG emissions for on-farm products (chosen at the beginning of the assessment by the end-user) are presented on the same model.

3.2 GHG profile

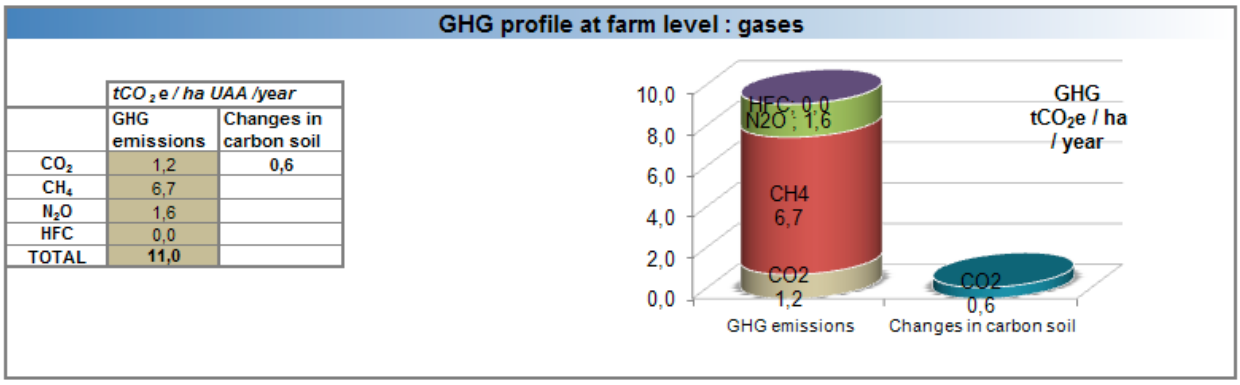


Figure 47: GHG profile at farm level

The GHG profile at farm level presents the annual gross GHG emissions as well as the annual variation in carbon stock.

The results are expressed in tCO_2e per ha of UAA and put forward the individual impact of each GHG: CO_2, CH_4 and N_2O.

3.3 GHG results and comparisons

3.3.1 Results at farm level

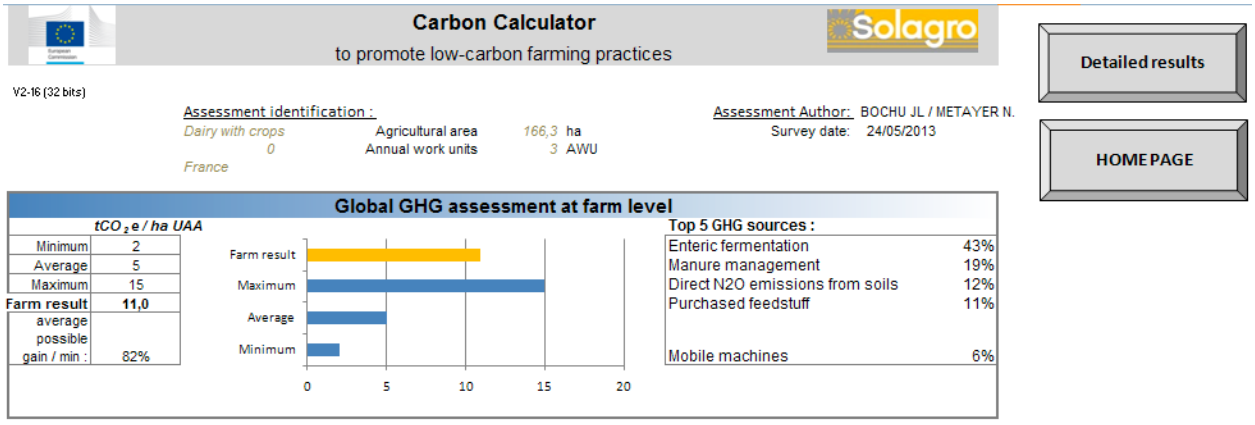


Figure 48: Comparison of GHG results at farm level

The Carbon Calculator reports the GHG emissions as total GHG emissions of the farm in tCO_2e of "ha UAA". This total is the addition of emissions from direct activities and from indirect activities.

On the left side of Figure 48, the user has the possibility to compare the results of the assessment (at farm level) with other results of similar farms. This possibility will be available

when a sufficient amount of assessments conducted with the tool will have been collected and analysed.

On the right side of Figure 48, the user can identify the five main sources of GHG emissions of the farm.

3.3.2 Results for the product

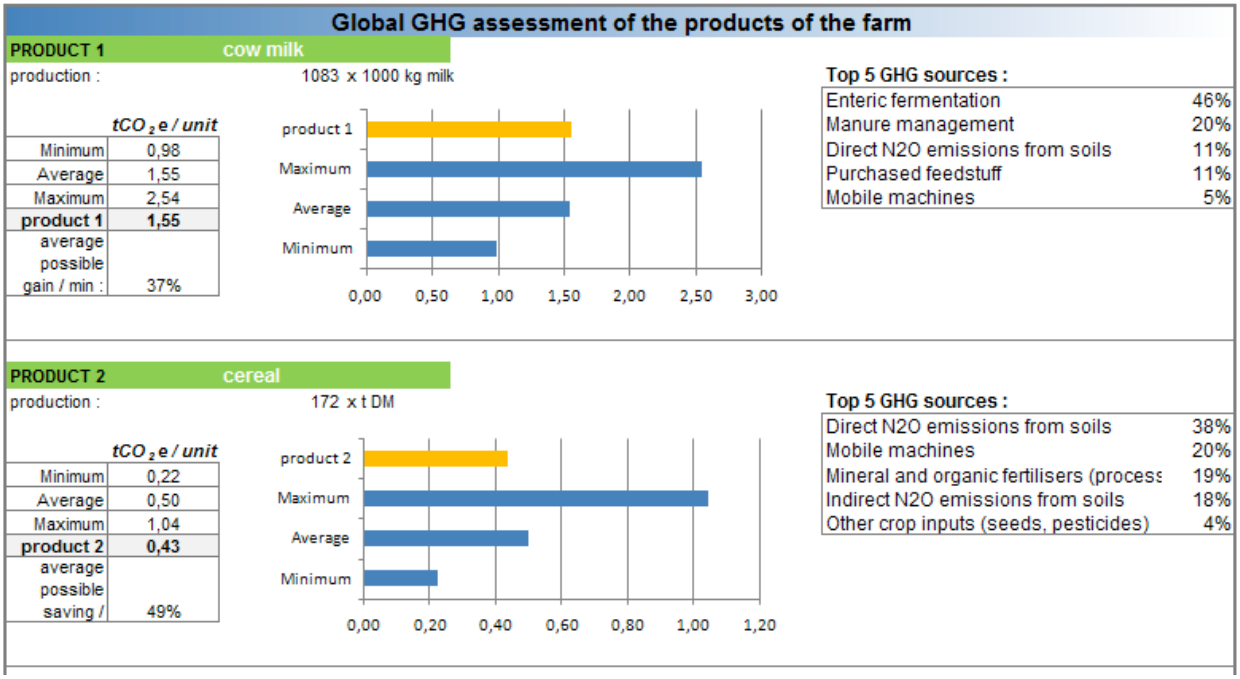


Figure 49: Comparison of GHG results at the product level (screenshot for products 1 and 2)

For the five main products of the farm, a presentation of the results similar to the one at farm level is available: total GHG emissions, comparison of the results with a reference and five main sources of GHG emissions.

3.4 Detailed sources of GHG emissions

Detailed sources of emissions, in accordance with the Organisational Environmental Footprint (OEF) and Product Environmental Footprint (PEF) presentations, are available for both farm level and product level.

3.4.1 At farm level

Carbon Calculator

GHG Assessment (annual flow) of the farm

Solagro

V2-17a (32 bits)

Assessment	
F_DairyCrops	166,3 ha
Dairy with crops	3,0 AWU
France	2010

Detailed GHG emissions sources and carbon storage

Current situation (tonnes / year)	tCO_2	tCH_4	tN_20	tHFC (in CO_2e)	tCO_2e	
1 GHG emissions from direct activities	**150**	**45**	**1**	**3**	**1 500**	82%
1-1 Machines and equipment	102	0	0	3	**105**	6%
Mobile machines	102			0	**102**	6%
Fixed machines	0			3	**3**	0%
1-2 Process emissions	48	45	1		**1 395**	76%
Enteric fermentation		31			**785**	43%
Manure management		13	0		**338**	19%
Direct N_2O emissions from soils			1		**212**	12%
Indirect N_2O emissions from soils			0		**60**	3%
Crop residues burnt		0	0		**0**	0%
2 GHG emissions from indirect activities	**48**	**0**	**0**	**0**	**326**	18%
2-1 GHG emissions of energy used on the farm and purchased by thirds	35	0	0		**35**	2%
Electricity purchased (i.e. on the grid)	28				**28**	2%
Collective irrigation (electricity or fuel for pumping)	8				**8**	0%
Fuels from thirds (operations done by contractors)	0				**0**	0%
2-2 GHG emissions for other purchased inputs	12	0	0		**291**	16%
Mineral and organic fertilisers (processing and transportation)					**64**	3%
Other crop inputs (seeds, pesticides)					**4**	0%
Secondary inputs (plastics and other petrochemicals)					**3**	0%
Purchased feedstuff					**197**	11%
Other animal inputs (purchased animals, rearing costs)					**0**	0%
Farm buildings and materials					**5**	0%
Machinery (and other equipments)					**6**	0%
Fuels manufacturing and transportation	12				**12**	1%
3 Total GHG emissions	**197**	**45**	**1**	**3**	**1 827**	100%
4 Additional environnemental information	**90**	**0**	**0**	**0**	**90**	
Changes in carbon stocks in natural infrastructures	30				**30**	2%
Changes in carbon stocks due to changes in soil management practices and land use	61				**61**	3%
Avoided GHG emissions due to the use of renewable energies in the farm instead of non renewable ones	0				**0**	0%
Avoided GHG emissions from the production and sale of renewable energies	0				**0**	0%

Figure 50: GHG emissions and change in carbon stock at farm level

3.4.2 At product level

In a second step, detailed GHG results for the 5 products of the farm are presented. A suitable functional unit is used depending of the product (tonne of milk, tonne of live weight for meat, tonne of dry matter, tonne of fresh matter, etc.).

Carbon Calculator

GHG Assessment (annual flow) of the product(s) of the farm

SAU : 166,3 ha

GHG distribution by products of the farm (tCO_2e / unit)

number of retained product	1	2	3	4	5	others	total farm
name of retained products	cow milk	Hwheat	sunflower	olive black	dairy meat	Other productions	
surface (ha)	141	31	14	1	3	4	194
Quantity produced	1083	144	28	6	10	0	0
Unit of the product	1000 kg milk	t DM	t DM	t of product	1000 kg meat	ha	0
total GHG emissions (tonnes CO_2e / unit of product)	1,55	0,45	0,36	0,05	4,20	8,81	TOTAL farm
	A	V	V	V	A	0	0
1 GHG emissions from direct activities	**1405,55**	**46,89**	**9,87**	**0,30**	**33,56**	**4,33**	**1500,48**
1-1 Machines and equipment	84,69	15,10	0,00	0,00	2,02	3,20	105,02
Mobile machines	84,69	15,10	0,00	0,00	2,02	0,28	102,09
Fixed machines	0,00	0,00	0,00	0,00	0,00	2,93	2,93
						0,00	0,00
1-2 Process emissions	1320,86	31,78	9,87	0,30	31,53	1,13	1395,47
Enteric fermentation	766,46	0,00	0,00	0,00	18,30	0,00	784,76
Manure management	330,53	0,00	0,00	0,00	7,89	0,00	338,42
Direct N2O emissions from soils	179,53	22,60	5,57	0,00	4,29	0,00	211,98
Indirect N2O emissions from soils	44,33	9,18	4,30	0,30	1,06	1,13	60,30
Crop residues burnt	0,00	0,00	0,00	0,00	0,00	0,00	0,00
2-1 GHG emissions of energy used on the farm and purchased by f	**19,31**	**0,40**	**0,00**	**0,00**	**0,46**	**15,17**	**35,35**
Electricity purchased (i.e. on the grid)	19,31	0,40	0,00	0,00	0,46	7,59	27,77
Collective irrigation (electricity or fuel for pumping)	0,00	0,00	0,00	0,00	0,00	7,59	7,59
Fuels from thirds (operations done by contractors)	0,00	0,00	0,00	0,00	0,00	0,00	0,00
2-2 GHG emissions for other purchased inputs	**254,50**	**17,73**	**0,20**	**0,00**	**6,08**	**12,22**	**290,73**
Mineral and organic fertilisers (processing and transportation)	48,97	14,02	0,00	0,00	1,17	-0,43	63,73
Other crop inputs (seeds, pesticides)	1,30	2,84	0,11	0,00	0,03	0,00	4,27
Secondary inputs (plastics and other petrochemicals)	2,29	0,22	0,00	0,00	0,05	0,00	2,56
Purchased feedstuff	192,14	0,00	0,00	0,00	4,59	0,35	197,09
Other animal inputs (purchased animals, rearing costs)	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Farm buildings and materials	5,13	0,02	0,00	0,00	0,12	0,00	5,28
Machinery (and other equipments)	4,56	0,61	0,09	0,00	0,11	0,15	5,52
Fuels manufacturing and transportation	0,10	0,02	0,00	0,00	0,00	12,15	12,28
3 Total GHG emissions	**1679,36**	**65,02**	**10,07**	**0,30**	**40,09**	**31,72**	**1826,56**
Changes in carbon stocks in natural infrastructures						29,69	29,69
Changes in carbon stocks due to changes in soil management practices and land use						60,63	60,63
Avoided GHG emissions due to the use of renewable energies in the farm instead of non renewable ones						0,00	0,00
Avoided GHG emissions from the production and sale of renewable energies						0,00	0,00

Figure 51: GHG emissions and change in carbon stock by product of the farm

3.5 Mitigation actions

GHG mitigation actions are automatically suggested to the user (Figure 52). The tool includes 16 possible mitigation actions. The 10 most effective mitigation actions to reduce GHG emissions on the assessed farm are presented in a table and in a figure in the Results –sheet of the Carbon Calculator (Figure 52). If the user has provided the optional financial data requested in the tool, the costs/gains from implementing the actions are also reported in the table.

An overview of the 16 actions calculated is detailed in another table that is located on the right side of the Results-sheet in the Carbon Calculator.

Mitigation / sequestration actions at farm level

Rank	Actions	tCO_2e saving / ha / year	New level of GHG / ha / year	% saving	EUR savings / farm / year (if available)		Links to action forms
	Current situation		10,9				not activate for the moment
1	Biogas production	1,9	9,1	17,1%	0		*hypertexte to pdf*
2	Adjust N fertiliser balance	0,9	10,0	8,4%	18 971		*hypertexte to pdf*
3	Agroforestry	0,6	10,3	5,8%	0		*hypertexte to pdf*
4	Soils covered all the year	0,4	10,6	3,3%	6 278		*hypertexte to pdf*
5	No-tillage	0,4	10,6	3,3%	0		*hypertexte to pdf*
6	Reduce methane from enteric fermentation	0,3	10,6	2,7%	0		*hypertexte to pdf*
7	Introduction of legumes in the rotation	0,3	10,7	2,5%	0		*hypertexte to pdf*
8	Solar panel on suitable buildings	0,2	10,7	2,2%	0		*hypertexte to pdf*
9	Implementation of hedges and other landscape elements	0,1	10,9	0,8%	0		*hypertexte to pdf*
10	Reduce engines fuel consumption (test and eco driving)	0,1	10,9	0,5%	2 006		*hypertexte to pdf*

The total net gain is not the sum of each action.

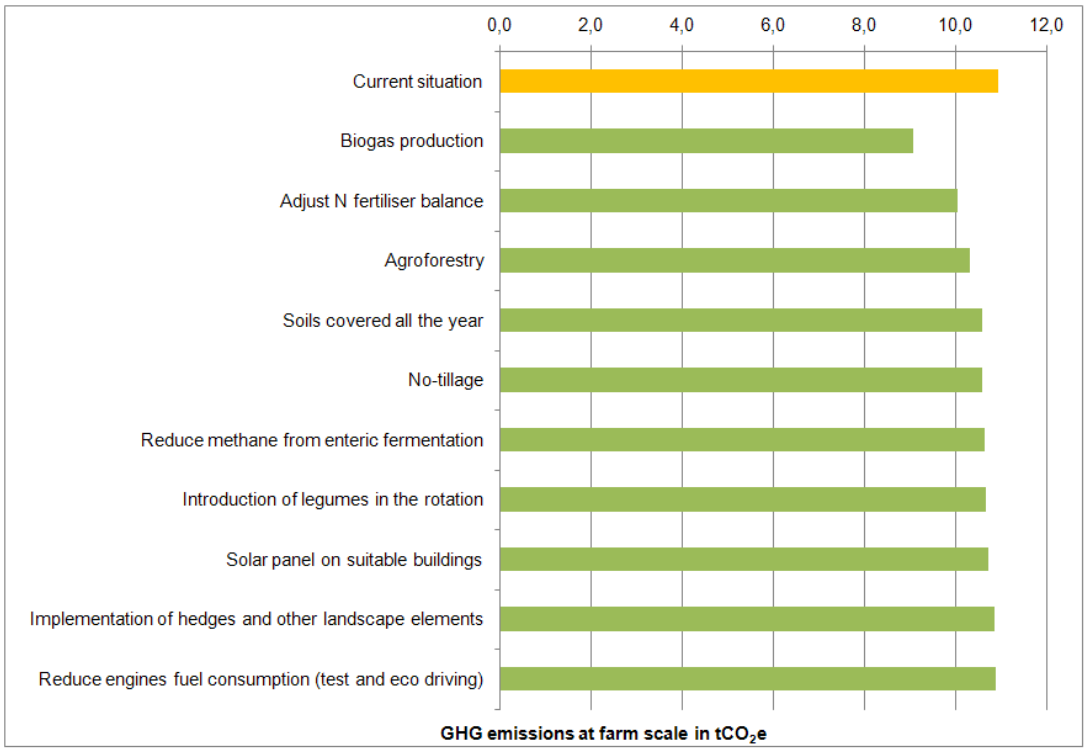


Figure 52: Mitigation actions

3.6 Environmental indicators

Figure 53 shows the three additional environmental indicators that are calculated at farm level:

- Water consumption in m^3,
- Direct primary energy consumption in GJ/ha,
- And the nitrogen surplus in kg N/ha.

A colour scale is provided to help analyse the nitrogen balance. The user can see more details about nitrogen inputs and outputs of the farm in the N balance sheet (see section 3.7).

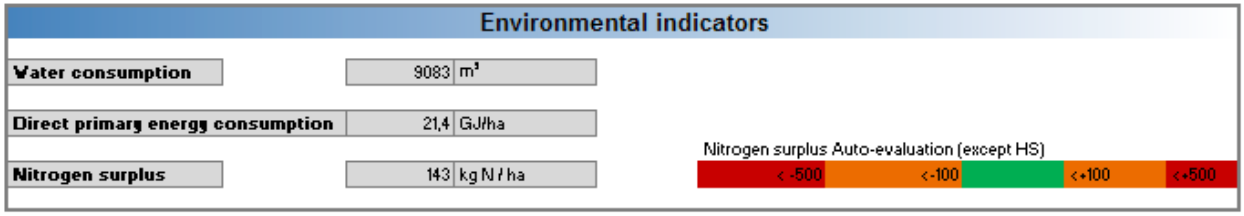


Figure 53: Environmental indicators of the farm

3.7 Nitrogen balance

A nitrogen balance is performed at farm level; it is the result of subtracting nitrogen exports from the total nitrogen inputs of the farm. This balance is calculated on the UAA of the farm.

Nitrogen balance = total inputs – total exports

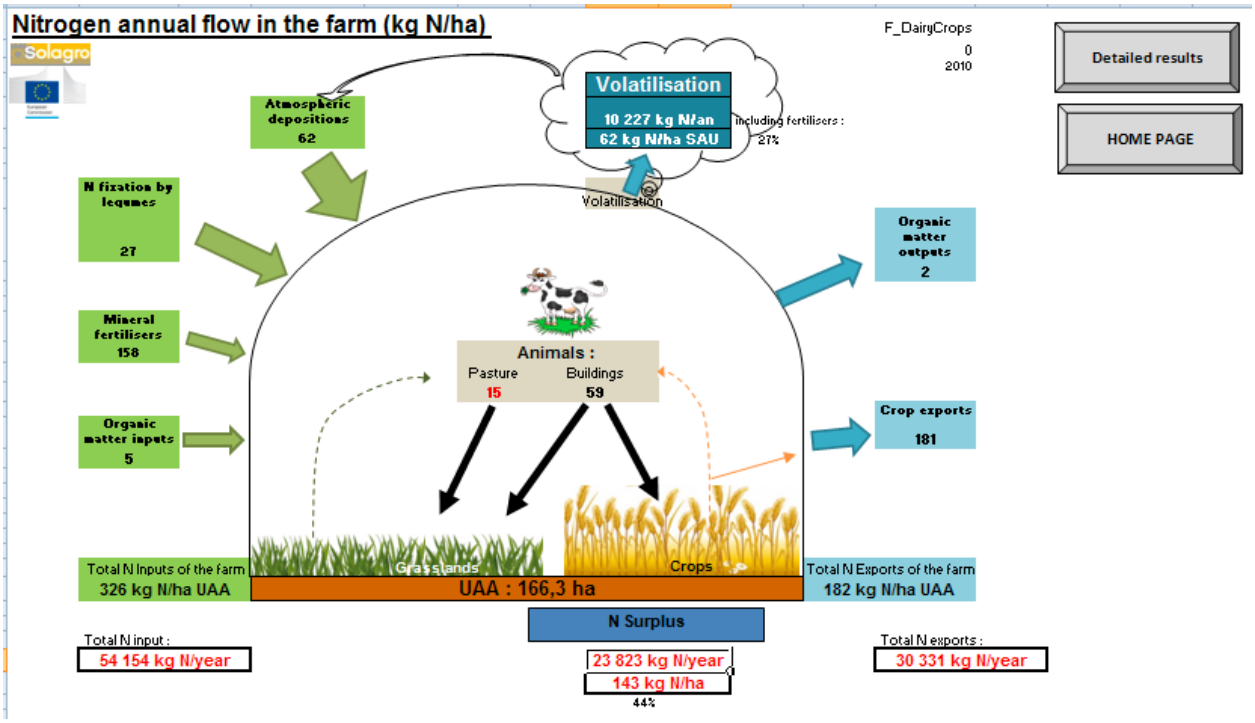


Figure 54: Nitrogen balance at farm level

The nitrogen balance highlights the annual nitrogen surplus at the farm level.

If the user observes a negative (or excessively positive) nitrogen surplus at the end of the assessment, they have to check that correct units were used when data was entered for crop yields, mineral fertilisers, livestock, and organic matter inputs and outputs.

4 Annex: Spring mean temperature (2007 to 2011)

Table 3: Spring mean temperature (2007 to 2011) per NUTS2 level (JRC)

Country	Nuts2	Region	Spring mean T (2007 to 2011)
Austria	AT11	Burgenland (AT)	15.36
Austria	AT12	Niederösterreich	15.10
Austria	AT13	Wien	15.76
Austria	AT21	Kärnten	14.28
Austria	AT22	Steiermark	14.34
Austria	AT31	Oberösterreich	14.87
Austria	AT32	Salzburg	13.67
Austria	AT33	Tirol	12.70
Austria	AT34	Vorarlberg	12.77
Belgium	BE10	5 Région de Bruxelles-Capitale / Brussels Hoofdstedelijk Gewest	12.82
Belgium	BE21	Prov. Antwerpen	12.77
Belgium	BE22	Prov. Limburg (BE)	13.07
Belgium	BE23	Prov. Oost-Vlaanderen	12.69
Belgium	BE24	Prov. Vlaams-Brabant	12.87
Belgium	BE25	Prov. West-Vlaanderen	12.26
Belgium	BE31	Prov. Brabant Wallon	12.91
Belgium	BE32	Prov. Hainaut	12.72
Belgium	BE33	Prov. Liège	13.22
Belgium	BE34	Prov. Luxembourg (BE)	13.47
Belgium	BE35	Prov. Namur	12.94
Bulgaria	BG31	Северозападен / Severozapaden	16.02
Bulgaria	BG32	Северен централен / Severen tsentralen	16.19
Bulgaria	BG31	Североизточен / Severoiztochen	15.25
Bulgaria	BG34	Югоизточен / Yugoiztochen	14.90
Bulgaria	BG41	Югозападен / Yugozapaden	14.46
Bulgaria	BG42	Южен централен / Yuzhen tsentralen	14.73
Czech Republic	CZ01	Praha	14.83
Czech Republic	CZ02	Střední Čechy	14.76
Czech Republic	CZ03	Jihozápad	14.69
Czech Republic	CZ04	Severozápad	14.59
Czech Republic	CZ05	Severovýchod	14.64

Czech Republic	CZ06	Jihovýchod	15.27
Czech Republic	CZ07	Střední Morava	15.24
Czech Republic	CZ08	Moravskoslezsko	15.01
Denmark	DK01	Hovedstaden	13.94
Denmark	DK02	Sjælland	13.67
Denmark	DK03	Syddanmark	13.22
Denmark	DK04	Midtjylland	13.10
Denmark	DK05	Nordjylland	13.27
Estonia	EE00	Eesti	16.04
Finland	FI19	Länsi-Suomi	15.11
Finland	FI13	Helsinki-Uusimaa	15.06
Finland	FI18	Etelä-Suomi	15.97
Finland	FI1A	Pohjois- ja Itä-Suomi	12.45
Finland	FI20	Åland	15.59
France	FR10	Île de France	12.81
France	FR21	Champagne-Ardenne	13.10
France	FR22	Picardie	12.43
France	FR23	Haute-Normandie	11.82
France	FR24	Centre	12.70
France	FR25	Basse-Normandie	11.43
France	FR26	Bourgogne	13.43
France	FR30	Nord - Pas-de-Calais	12.27
France	FR41	Lorraine	13.64
France	FR42	Alsace	14.15
France	FR43	Franche-Comté	13.97
France	FR51	Pays de la Loire	12.40
France	FR52	Bretagne	11.39
France	FR53	Poitou-Charentes	12.88
France	FR61	Aquitaine	13.07
France	FR62	Midi-Pyrénées	12.74
France	FR63	Limousin	12.68
France	FR71	Rhône-Alpes	13.47
France	FR72	Auvergne	12.53
France	FR81	Languedoc-Roussillon	13.18
France	FR82	Provence-Alpes-Côte d'Azur	13.37
France	FR83	Corse	12.60
Germany	DE11	Stuttgart	14.20
Germany	DE12	Karlsruhe	14.24
Germany	DE13	Freiburg	14.37
Germany	DE14	Tübingen	14.34
Germany	DE21	Oberbayern	14.35
Germany	DE22	Niederbayern	14.78
Germany	DE23	Oberpfalz	14.72
Germany	DE24	Oberfranken	14.72
Germany	DE25	Mittelfranken	14.43
Germany	DE26	Unterfranken	14.27
Germany	DE27	Schwaben	14.00
Germany	DE30	Berlin	14.70

Germany	DE41	Brandenburg	14.43
Germany	DE50	Bremen	13.52
Germany	DE60	Hamburg	13.25
Germany	DE71	Darmstadt	14.13
Germany	DE72	Gießen	13.94
Germany	DE73	Kassel	13.83
Germany	DE80	Mecklenburg-Vorpommern	13.87
Germany	DE91	Braunschweig	13.55
Germany	DE92	Hannover	13.53
Germany	DE93	Lüneburg	13.55
Germany	DE94	Weser-Ems	13.26
Germany	DEA1	Düsseldorf	13.25
Germany	DEA2	Köln	13.33
Germany	DEA3	Münster	13.27
Germany	DEA4	Detmold	13.48
Germany	DEA5	Arnsberg	13.52
Germany	DEB1	Koblenz	13.80
Germany	DEB2	Trier	13.86
Germany	DEB3	Rheinhessen-Pfalz	14.14
Germany	DEC0	Saarland	14.01
Germany	DED2	Dresden	14.45
Germany	DED1	Chemnitz	14.29
Germany	DED3	Leipzig	13.97
Germany	DEE0	Sachsen-Anhalt	13.83
Germany	DEF0	Schleswig-Holstein	13.25
Germany	DEG0	Thüringen	13.96
Greece	GR11	Ανατολική Μακεδονία, Θράκη / Anatoliki Makedonia, Thraki	14.19
Greece	GR12	Κεντρική Μακεδονία / Kentriki Makedonia	14.39
Greece	GR13	Δυτική Μακεδονία / Dytiki Makedonia	14.10
Greece	GR14	Θεσσαλία / Thessalia	13.61
Greece	GR21	Ήπειρος / Ipeiros	13.07
Greece	GR22	Ιόνια Νησιά / Ionia Nisia	13.20
Greece	GR23	Δυτική Ελλάδα / Dytiki Ellada	12.96
Greece	GR24	Στερεά Ελλάδα / Sterea Ellada	13.22
Greece	GR25	Πελοπόννησος / Peloponnisos	13.15
Greece	GR30	Αττική / Attiki	13.62
Greece	GR41	Βόρειο Αιγαίο / Voreio Aigaio	13.34
Greece	GR42	Νότιο Αιγαίο / Notio Aigaio	14.32
Greece	GR43	Κρήτη / Kriti	14.03

Hungary	HU10	Közép-Magyarország	16.27
Hungary	HU21	Közép-Dunántúl	16.00
Hungary	HU22	Nyugat-Dunántúl	15.44
Hungary	HU23	Dél-Dunántúl	15.64
Hungary	HU31	Észak-Magyarország	16.49
Hungary	HU32	Észak-Alföld	16.56
Hungary	HU33	Dél-Alföld	16.06
Ireland	IE01	Border, Midland and Western	10.29
Ireland	IE02	Southern and Eastern	10.24
Italy	ITC1	Piemonte	14.12
Italy	ITC2	Valle d'Aosta/Vallée d'Aoste	11.87
Italy	ITC3	Liguria	13.79
Italy	ITC4	Lombardia	14.99
Italy	ITF1	Abruzzo	13.25
Italy	ITF2	Molise	13.18
Italy	ITF3	Campania	13.01
Italy	ITF4	Puglia	12.95
Italy	ITF5	Basilicata	12.80
Italy	ITF6	Calabria	12.88
Italy	ITG1	Sicilia	13.15
Italy	ITG2	Sardegna	12.99
Italy	ITD1	Provincia Autonoma di Bolzano/Bozen	12.68
Italy	ITD2	Provincia Autonoma di Trento	14.23
Italy	ITD3	Veneto	15.57
Italy	ITD4	Friuli-Venezia Giulia	15.07
Italy	ITD5	Emilia-Romagna	15.37
Italy	ITE1	Toscana	13.42
Italy	ITE2	Umbria	13.54
Italy	ITE3	Marche	14.08
Italy	ITE4	Lazio	13.00
Latvia	LV00	Latvija	15.98
Lithuania	LT00	Lietuva	16.07
Luxembourg	LU00	Luxembourg	14.03
Malta	MT00	Malta	14.64
Netherlands	NL11	Groningen	12.90
Netherlands	NL12	Friesland (NL)	12.69
Netherlands	NL13	Drenthe	12.95
Netherlands	NL21	Overijssel	12.87
Netherlands	NL22	Gelderland	12.83
Netherlands	NL23	Flevoland	12.76
Netherlands	NL31	Utrecht	12.61
Netherlands	NL41	Noord-Holland	12.44
Netherlands	NL33	Zuid-Holland	12.36
Netherlands	NL34	Zeeland	12.55
Netherlands	NL41	Noord-Brabant	12.78

Netherlands	NL42	Limburg (NL)	13.15
Poland	PL11	Łódzkie	15.50
Poland	PL12	Mazowieckie	15.09
Poland	PL21	Małopolskie	15.66
Poland	PL22	Śląskie	15.20
Poland	PL31	Lubelskie	15.96
Poland	PL32	Podkarpackie	15.58
Poland	PL33	Świętokrzyskie	15.52
Poland	PL34	Podlaskie	15.75
Poland	PL41	Wielkopolskie	15.19
Poland	PL42	Zachodniopomorskie	14.50
Poland	PL31	Lubuskie	14.90
Poland	PL51	Dolnośląskie	14.60
Poland	PL52	Opolskie	15.06
Poland	PL61	Kujawsko-Pomorskie	15.30
Poland	PL62	Warmińsko-Mazurskie	15.45
Poland	PL63	Pomorskie	14.56
Portugal	PT11	Norte	12.66
Portugal	PT15	Algarve	14.65
Portugal	PT16	Centro (PT)	13.55
Portugal	PT17	Lisboa	14.92
Portugal	PT18	Alentejo	14.35
Romania	RO11	Nord-Vest	15.79
Romania	RO12	Centru	15.26
Romania	RO21	Nord-Est	16.32
Romania	RO22	Sud-Est	16.47
Romania	RO31	Sud - Muntenia	16.40
Romania	RO32	Bucureşti - Ilfov	16.77
Romania	RO41	Sud-Vest Oltenia	16.00
Slovakia	SK01	Bratislavský kraj	15.87
Slovakia	SK02	Západné Slovensko	15.79
Slovakia	SK03	Stredné Slovensko	15.43
Slovakia	SK04	Východné Slovensko	15.56
Slovenia	SI01	Vzhodna Slovenija	15.01
Slovenia	SI02	Zahodna Slovenija	14.95
Spain	ES11	Galicia	12.01
Spain	ES12	Principado de Asturias	11.29
Spain	ES13	Cantabria	11.36
Spain	ES21	País Vasco	12.09
Spain	ES22	Comunidad Foral de Navarra	12.71
Spain	ES23	La Rioja	12.19
Spain	ES24	Aragón	12.71
Spain	ES30	Comunidad de Madrid	13.11
Spain	ES41	Castilla y León	11.91
Spain	ES42	Castilla-La Mancha	12.98
Spain	ES43	Extremadura	13.75
Spain	ES51	Cataluña	12.88
Spain	ES52	Comunidad Valenciana	13.26

Spain	ES53	Illes Balears	13.47
Spain	ES61	Andalucía	13.97
Spain	ES62	Región de Murcia	13.63
Spain	ES63	Ciudad Autónoma de Ceuta	15.35
Spain	ES64	Ciudad Autónoma de Melilla	14.70
Spain	ES70	Canarias	18.26
Sweden	SE11	Stockholm	15.05
Sweden	SE12	Östra Mellansverige	14.77
Sweden	SE21	Småland med öarna	14.32
Sweden	SE22	Sydsverige	13.98
Sweden	SE23	Västsverige	14.26
Sweden	SE31	Norra Mellansverige	13.80
Sweden	SE32	Mellersta Norrland	12.80
Sweden	SE33	Övre Norrland	11.83
United Kingdom	UKC1	Tees Valley and Durham	10.34
United Kingdom	UKC2	Northumberland and Tyne and Wear	10.20
United Kingdom	UKD1	Cumbria	10.43
United Kingdom	UKD3	Greater Manchester	10.74
United Kingdom	UKD4	Lancashire	10.63
United Kingdom	UKD2	Cheshire	10.70
United Kingdom	UKD5	Merseyside	10.73
United Kingdom	UKE1	East Yorkshire and Northern Lincolnshire	10.51
United Kingdom	UKE2	North Yorkshire	10.47
United Kingdom	UKE3	South Yorkshire	10.80
United Kingdom	UKE4	West Yorkshire	10.68
United Kingdom	UKF1	Derbyshire and Nottinghamshire	10.96
United Kingdom	UKF2	Leicestershire, Rutland and Northamptonshire	11.09
United Kingdom	UKF3	Lincolnshire	10.98
United Kingdom	UKG1	Herefordshire, Worcestershire and Warwickshire	10.94
United Kingdom	UKG2	Shropshire and Staffordshire	10.67
United Kingdom	UKG3	West Midlands	10.89
United Kingdom	UKH1	East Anglia	11.12
United Kingdom	UKH2	Bedfordshire and Hertfordshire	11.15
United Kingdom	UKH3	Essex	11.27
United Kingdom	UKI1	Inner London	1178
United Kingdom	UKI2	Outer London	11.48
United Kingdom	UKJ1	Berkshire, Buckinghamshire and Oxfordshire	11.09

United Kingdom	UKJ2	Surrey, East and West Sussex	11.25
United Kingdom	UKJ3	Hampshire and Isle of Wight	11.07
United Kingdom	UKJ4	Kent	11.21
United Kingdom	UKL1	West Wales and The Valleys	10.43
United Kingdom	UKL2	East Wales	10.62
United Kingdom	UKM2	Eastern Scotland	10.21
United Kingdom	UKM3	South Western Scotland	10.07
United Kingdom	UKM5	North Eastern Scotland	9.1
United Kingdom	UKM6	Highlands and Islands	9.52
United Kingdom	UKN0	Northern Ireland	10.29
United Kingdom	UKK1	Gloucestershire, Wiltshire and Bristol/Bath area	11.08
United Kingdom	UKK2	Dorset and Somerset	10.72
United Kingdom	UKK3	Cornwall and Isles of Scilly	10.39
United Kingdom	UKK4	Devon	10.49