

Agrosyst

Calculated indicators



Presentation of the indicators calculated by Agrosyst

This guide presents the different indicators of cropping systems calculated by Agrosyst, which allow to describe the socio-technical and economic results of the cropping system.

It also includes some general calculation principles for all or some of the indicators (economic indicators).

These indicators are calculated and exportable from Agrosyst via the "Performances" page of the information system. To know the steps to follow to generate performances in Agrosyst, you can refer to the Agrosyst Guideline.

/!\ This document The document was translated from French to English by an automatic translator. It has been corrected and adapted but some notions may not be very explicit. If you have any questions, please do not hesitate to contact us: agrosyst-impworks@inrae.fr

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⇒ Some principles for calculating the indicators

○ Calculation of the Proportion of the Surface Area Concerned by the Intervention y (PSC_i)

The Proportion of area affected by an intervention (PSC_i, without unit) is calculated for each intervention. It is used for the calculation of all indicators.

• Calculation of PSC_i

PSC_i is equal to:

$$PSC_i = \text{spatial frequency} \times \text{temporal frequency}$$

Spatial frequency (without unit): spatial frequency of an intervention (varies from 0 to 1, 1 meaning "on the whole surface"). It corresponds to the proportion of the surface of the field surveyed by the combination of tools used (intervention on the entire surface of the crop, intervention on 50% of the surface, etc.). Data entered by the user.

Temporal frequency (without unit): temporal frequency of an intervention (varies from 0 to x). It corresponds to the annual frequency of intervention (see examples below). Data entered by the user.

- intervention 1 year out of 2: temporal frequency of 0.5;
- intervention every year: temporal frequency of 1;
- x interventions per year: temporal frequency of x.

• Case of the application of plant protection products registered or not: the proportion of surface treated

In the case of an application of one or more registered or non- registered PPP, a so-called "phyto" PSC_i is calculated, which involves an additional notion: the "proportion of surface treated". It corresponds to the proportion of the surface surveyed by the agricultural equipment that actually receives the treatment (*Proportion of treated area* - between 0 and 100%) and is taken into account for the calculation of the various Treatment Frequency Indices (TFI). The *Proportion of area treated* is calculated in the same way for the systems implemented and synthesised.

PSC_i (phyto) (without unit): proportion of surface concerned by the action of type **application of PPP**:

$$PSC_i(\text{phyto}) = PSC_i \times \frac{\text{proportion of treated area}}{100}$$

Proportion of treated area (%): within the surface concerned by the passage of the combination of tools or the manual operation of the intervention, proportion effectively receiving the treatment (varying from 0 to 100). Data entered by the user in the "**Registered products (Chemical and non-chemical PPP)**" or "**Biocontrol and non-registered products**" action. For example, the proportion of treated area is less than 100% for treatments localised on the row of the crop.

○ List of calculated indicators and aggregation scales

Indicators are usually calculated at the intervention level and then aggregated at higher levels to define performance at the crop-predecessor, area, plot, cropping system and farm levels.

Gross product, gross margin, semi-net margin and direct margin are defined only at the scale of the crop-predecessor pair, and aggregated at higher scales thereafter.

The scales of aggregation for which the indicators are calculated differ for a system reported as realised and a system reported as synthesised.

• Scales of aggregation at the scale of the *realised system* and the *synthesised system*

	<u>Intervention</u>	<u>Input</u>	<u>Crop</u>	<u>Cropping system</u>	<u>Farm</u>
Treatment Frequency Index	x	x	x	x	x
Gross Product			x	x	x
Operating expenses	x	x	x	x	x
Gross margin			x	x	x
Mechanisation costs	x		x	x	x
Cost of fuel	x		x	x	x
Semi-net margin			x	x	x
Labour costs	x		x	x	x
Manual labour costs	x		x	x	x
Direct margin			x	x	x
Time of use of the material	x		x	x	x
Manual work time	x		x	x	x

The input scale allows the calculation of the crop and target-based IFTs and the operational costs of each input for an intervention, thus allowing differentiation of products when an intervention contains several.

In practice, the rotation scheme conditions the aggregation, as well as the campaign(s) (year(s)) for which this cropping system is declared.

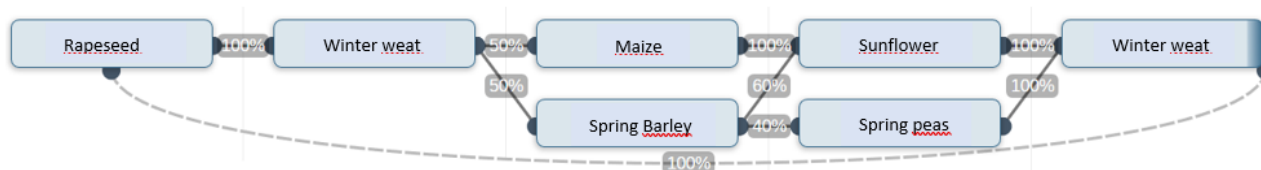
○ Aggregation of indicators at the scale of the cropping system in summary

In the case of a synthesised cropping system, the user can represent complex crop rotations, with several possible alternative crops for one or more rotation terms.

Each of these alternatives leads to the definition of paths (i.e. the different crop successions that can be performed) in the rotation.

• Calculation in the case of a synthesised cropping system with several paths

Here is an example of a rotation description of a cropping system described in Agrosyst, with several defined paths.



In the example above, there are three possible paths (over 5 crop years) for the synthesised system described:

- Path 1: Rapeseed / Winter wheat / Maize / Sunflower / winter wheat
- Path 2: Rapeseed / Winter wheat / Spring Barley / Sunflower / winter wheat
- Path 3: Rapeseed / Winter wheat / Spring Barley / Spring peas / winter wheat

To calculate the value of an indicator y, 3 successive steps are necessary:

- 1. Sum up the values of indicator y for all crops on a path.
- 2. Take a weighted average of the values obtained for the different paths. The weighting is done by calculating the relative importance of each path (see next paragraph).
- 3. Divide the average value obtained by the number of years of the paths (in this case, five years). If the paths have different lengths, calculate an average number of years weighted by the relative importance of the paths.

In order to calculate the relative importance of each path (the weight P_i , which will be used for the weighted average - see previous paragraph), we use the frequencies of appearance of each crop. Thus, we obtain :

- $P_1 = 1 * 0.5 * 1 * 1 = 0.5$ for path 1
- $P_2 = 1 * 0.5 * 0.6 * 1 = 0.3$ for path 2
- $P_3 = 1 * 0.5 * 0.4 * 1 = 0.2$ for path 3

The sum of the frequencies of occurrence of the different paths must be equal to 1 (100%), which is the case here.

Example of calculation of an indicator at the summary level: $IF_{\text{Herbicides}}$

Let's take the following values:

- $IF_{\text{Herbicides}}$ for rapeseed, spring barley and spring peas = 1
- $IF_{\text{Herbicides}}$ for winter wheat = 1.5
- $IF_{\text{Herbicides}}$ for maize and sunflower = 0

1. Sum of the $IF_{\text{Herbicides}}$ indicator for each path of the rotation:

- *Path 1:* $1 + 1.5 + 0 + 0 + 1.5 = 4$
- *Path 2:* $1 + 1.5 + 1 + 0 + 1.5 = 5$
- *Path 3:* $1 + 1.5 + 1 + 1 + 1.5 = 6$

2. Calculation of the weighted sum of the paths (P_1 , P_2 and P_3): $0.5*4 + 0.3*5 + 0.2*6 = 4.7$

3. Calculation of the average value per campaign for the synthesised system: $IF_{\text{Herbicides}} = 4.7 / 5 = 0.94$.

Remark: Calculation by Agrosyst when one or more crops are absent

The user can declare that one or more crops of the cropping system are absent from the field during the campaign(s) for which the system is registered. These absent crops are taken into account in the calculation of the average performance of the indicators at the level of the cropping system.

⇒ Treatment Frequency Index (TFI)

Presentation of the indicator

The indicator for monitoring the use of plant protection products in the DEPHY network is the Treatment Frequency Indicator (TFI). The TFI makes it possible to evaluate the intensity of the use of phytosanitary products: it counts the number of reference doses of a commercial speciality with a registration, used on one hectare during a given period.

Its current definition does not take into account the target (or group of targets) of the treatment. Thus, for a crop*product pair, the reference dose used in the calculation is the **minimum registration dose** of the product on this crop, all targets included. **The TFI does not take into account the products used to treat harvested products, nor products that are exclusively adjuvants and biocides.**

/Note: Consideration of the target in the calculation of the TFI

The 'historical' TFI (crop-based TFI), which could be calculated for all campaigns and was the only version available until Agrosyst version 2.57, did not take into account the treatment target for the determination of the reference dose. Since version 2.57, the calculation of the target-based TFI is possible, only for the 2015 campaign and more recent campaigns (as the reference frame provided by the Ministry of Agriculture starts in 2015).

The TFI is broken down into several components, which are specified in the following summary table.

Note: TFI biocontrol and non-registered products

Historically, both the biocontrol TFI and the "Use of biological means" indicators could be calculated for the application of the same commercial product, if it belonged to the list of biological control products (ACTA 2017 classification) and to the list of biocontrol products (MAA 2020 classification)

In order to avoid this situation and to match the classification of the MAA which now provides the data for Agrosyst, plant protection products are divided **into two new categories: Registered products (Chemical and non-chemical PPP) and Biocontrol and non-registered products.**

For each input of a "biological control", there is no reference dose. For this reason, the indicator of biological control (macro-organisms and non-registered products) is not an TFI. In fact, for this type of action, the indicator takes the value 1.

Summary table of the different TFIs calculated:

Name	Types of products counted (excluding 'use of biological means without MA')
Total chemical TFI (including seed coating but excluding low impact PPPs)	All, - except biocontrol
Total chemical TFI excluding seed coating (and excluding low impact PPPs)	All, - except seed coating - except biocontrol
TFI herbicide	Herbicides, - except biocontrol
TFI fungicide	Fungicides, - except biocontrol
TFI insecticide	Insecticides, - except biocontrol
TFI seed coating	Seed coating, - except for biological inoculation - except biocontrol
TFI other ¹	All, - except herbicides - except fungicides - except insecticides - except biocontrol - except seed treatments
Non-herbicide TFI (including seed coating but excluding low impact PPPs)	All, - except herbicides - except for biological inoculation - except biocontrol
TFI "low impact PPPs"	Products included in the list of biocontrol products established by the MAA

List of treatment types classified in the declination IFT other (IFT a)² :

Diverse - Corvifuges - Corvicides
Associations - Treatment of aerial parts
Diverse – anti-moss
Diverse - Anti-perspirant
Diverse - Diverse - Anti-russetting
Diverse - Rodenticides
Diverse - Taupicides

¹ See list of relevant treatment types after the table.

² In addition to the types of treatments in this list, 9 of the 50 natural defences stimulators (NDS) contained in Agrosyst are included in this list of "other" products.

Diverse - Fighting Virus Diseases
 Diverse - Growth substances
 Diverse - Bird and game repellents
 Diverse - Nematicides
 Diverse - Protection of pruning wounds
 Diverse - Molluscicides
 Diverse - Unknown

Calculation formula

TFI_k (without unit): TFI of the application of input k during action a , intervention i . There are three possible types for action a : Application of registered plant protection product, application of biocontrol and non-registered product, sowing.

$$TFI_k = \frac{DA_k}{DR_k} \times PSC_a \text{ with } PSC_a = \begin{cases} PSCi \text{ (phyto) if action type} \\ \text{'Registered products' or 'Biocontrol and non registered products'} \\ PSCi \text{ if action de type 'Sowing'} \end{cases}$$

$TFI(x)_i$ (without unit): TFI of intervention i , where x designates the type of TFI calculated (total, total excluding seed coating, herbicide, etc., cf. Summary table of the different TFIs), according to the types of products applied.

$$IFT(x)_i = \sum_k IFT_k$$

Details :

PSC_a (no units): Proportion of the area concerned by action a (contained in intervention i). Depending on the type of action, it takes one of the following two values: PSC_i or PSC_i (phyto).

PSC_i , PSC_i (phyto) (without unit) : Proportion of surface concerned by the intervention, by an application of a plant protection product, registered or not. Calculated data, definition available on p. 4.

DA_k (various units): dose of commercial speciality k applied during an intervention. Data entered by the user (the user enters the dose applied and selects the unit from a list of values). If the dose is expressed per hL, it must be multiplied by the volume of spray mixture applied per ha (data entered by the user).

DR_k (various units): reference dose of the commercial product applied. Calculated data. For the calculation of the crop-based TFI, it is a data calculated from the registered doses for the different uses of the commercial product on the crop, contained in the reference system provided by ACTA. For the calculation of the target-based TFI, it is a data calculated from the reference dose(s) included in the reference system provided by the Ministry of Agriculture, for the most recent crop year.

Choice of the unit declared by the user

If there is a reference rate for the product * crop (* target) combination, the unit used to express this reference is compulsorily used to enter the applied rate in Agrosyst. Otherwise, the user is free to choose the unit in which to express the applied quantity.

/!\ Default value

If there is no existing reference dose in the reference system for the crop * product pair k , then the reference dose is considered to be equal to the applied dose ($DA_k / DR_k = 1$). Therefore, for a treatment applied to the entire surface ($PSC_a = 1$), we will have an $TFI_k = 1$.

Reference data

For the crop-based TFI, the registered rates of a commercial product for a use are used to calculate a reference rate for the application of that commercial product to a species (or group of species).

These registered doses come from a reference system historically provided by ACTA, with a last update from the Ministry of Agriculture in 2019 and occasional updates at the request of users.

For the target-based TFI, the reference doses per combination crop * commercial speciality * target are provided by the Ministry of Agriculture, updated automatically every year.

This repository is completed by a repository establishing the correspondence between the targets declared by Agrosyst users (provided by AgroEDI Europe) and the targets defined by the Ministry (which are target groups).

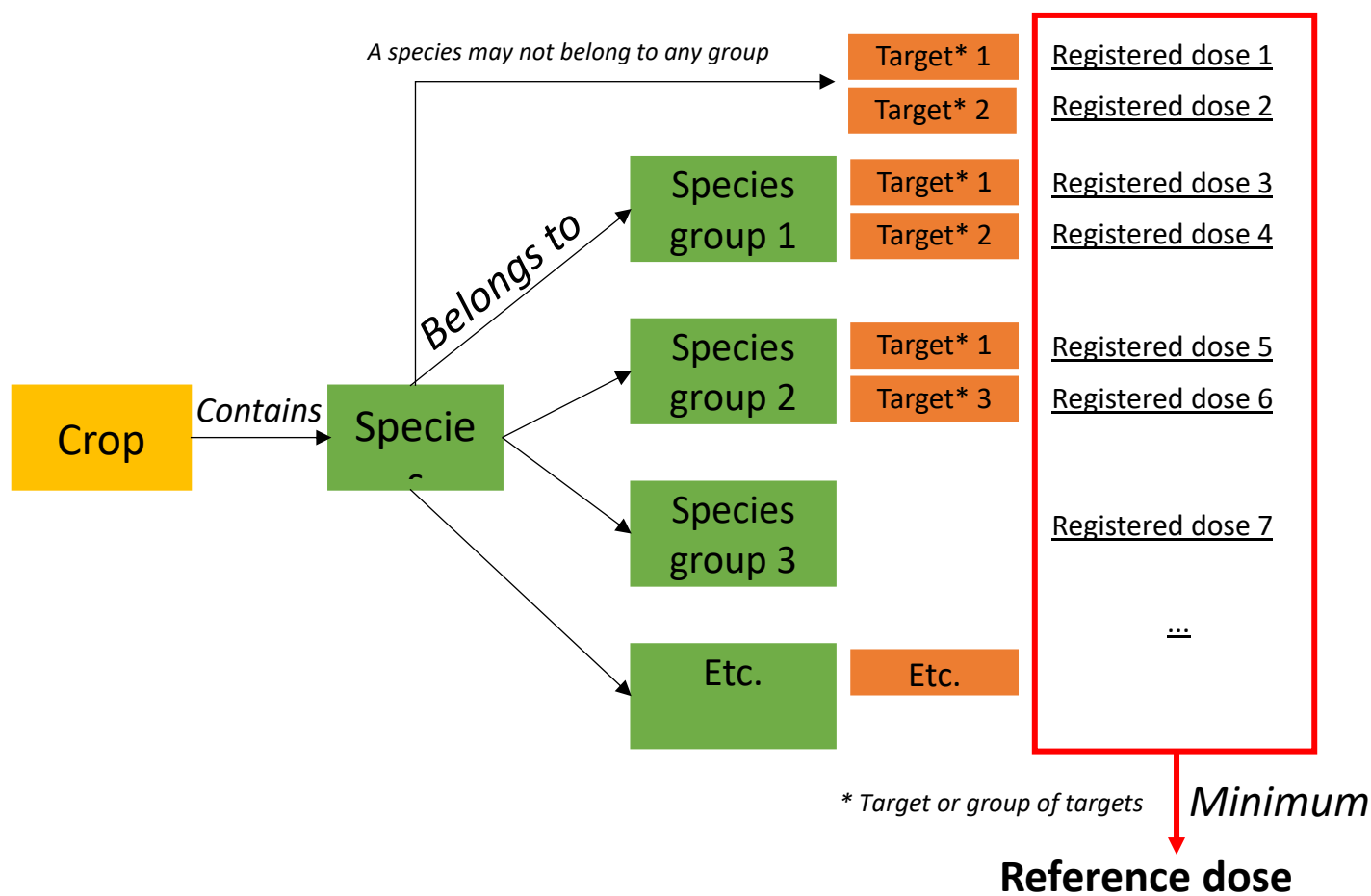
The details of the calculation of the reference dose for the crop-based TFI and the target-based TFI are presented in the following diagrams. These principles are valid **for main crops or intermediate crops**.

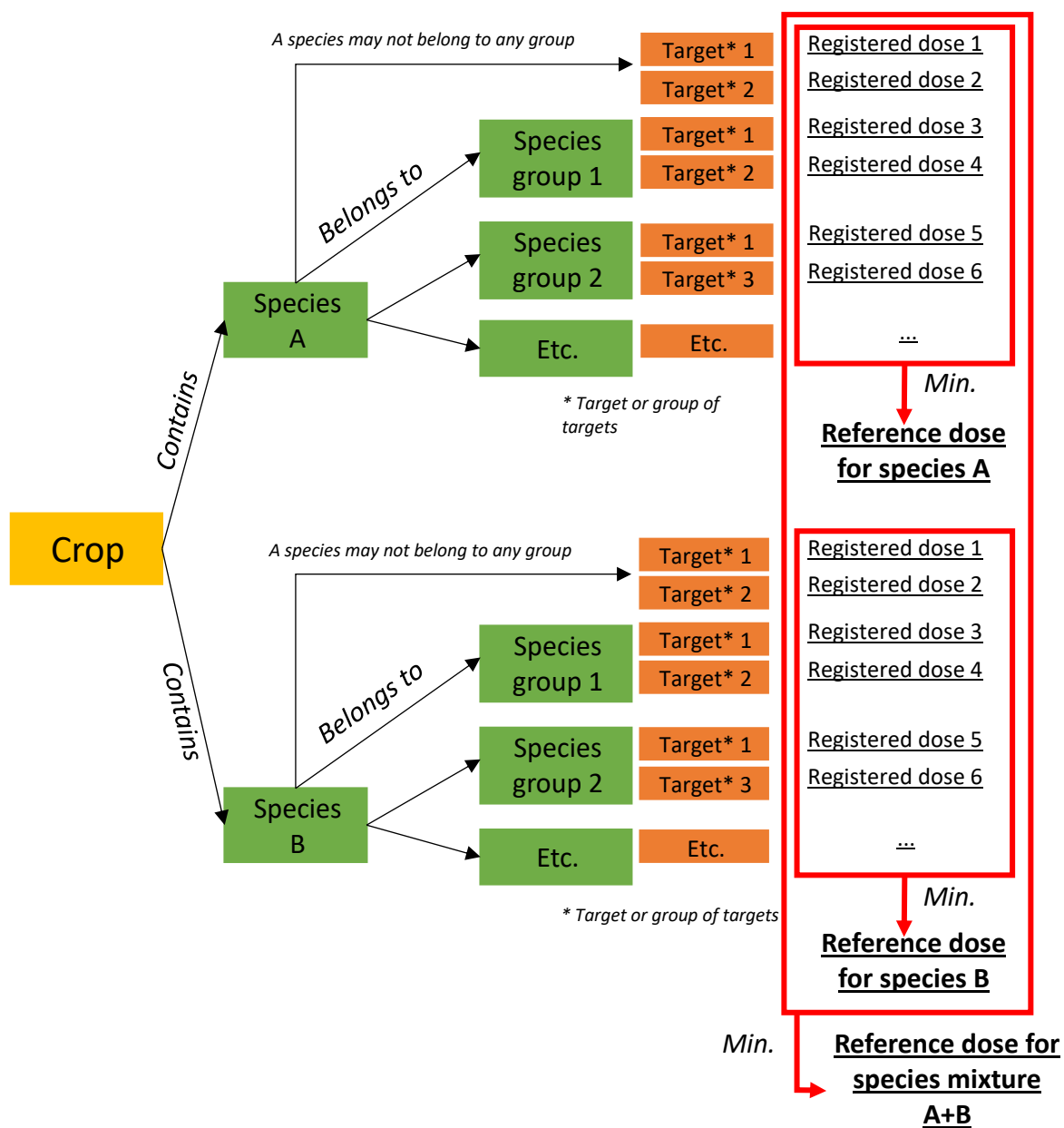
Calculation of reference doses

The principles for calculating reference doses are presented in three diagrams.

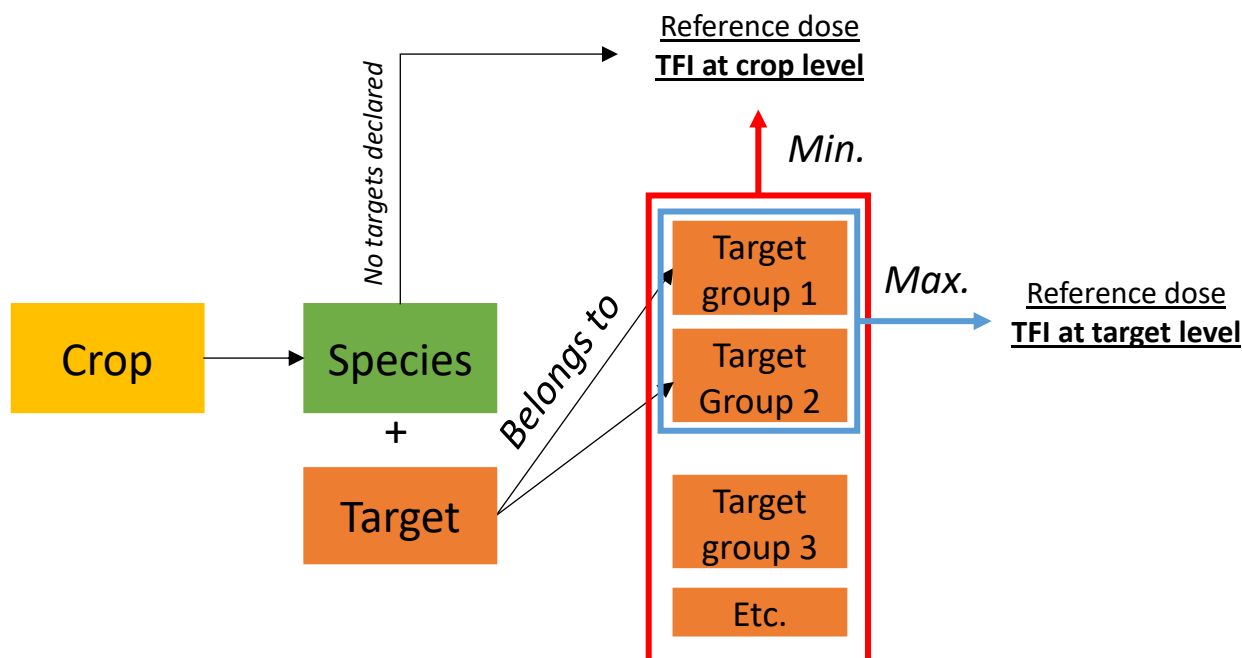
- 1: crop-based TFI for a single species crop
- 2: crop-based TFI for a mixed species crop
- 3: target-based IFT

Case 1: TFI for a single species crop





Case 2: TFI for a crop composed of a multi-species mixture



Case 3: Reference dose for target-based TFI

The calculation principle remains the same when several species and/or several targets are declared for the application of the same commercial speciality. After having identified all the existing reference doses in the reference system related to the combination of commercial speciality * species * target(s), we retain:

- The **lowest** existing reference dose for **crop TFI**.
- The **highest** existing reference dose for **the target TFI**.

⇒ Working time indicators

The working time indicators take into account the time spent using equipment (i.e. interventions declared with a combination of tools) and manual working time.

They are calculated for the whole crop year, but also for each calendar month, in hours per hectare (h/ha). There are therefore 13 versions of each indicator.

For all working time indicators, if an intervention is reported over a period of two months or more, the distribution of monthly working time is done by taking into account the number of days in each month included in the intervention period compared to the total number of days in the intervention period.

Example: for an intervention declared over a period from 24/05 to 02/06 inclusive (i.e. a duration of 10 days) with a total working time of 1h/ha:

- The working time associated with the month of May (from 24 to 31/05, 8 days) is $1 \times 8/10 = 0.8$ h/ha;
- The working time associated with the month of June (from 01 to 02/06, 2 days) is $1 \times 2/10 = 0.2$ h/ha.

○ Time of use of the equipment

Presentation of the indicator

The time of use of the equipment is expressed in h/ha. It is calculated for **interventions associated with tool combinations**. It is equal to 0 for interventions without tool combinations.

It depends on the work rate, taken from the BCMA reference system or entered by the user, expressed in h/ha or ha/h. For certain combinations of tools, the user can choose to enter the work rate in a unit other than h/ha or ha/h. In these cases, the mechanised working time formula is adapted and an additional input is required for the calculation. For all types of implement combinations, the unit of output and the formula for calculating mechanised working time are shown in the following table.

Calculation formula

Relevant tool combinations	Construction rate units	Mechanised working time _i
All tool combinations	h/ha	$= \text{PSCi} \times \text{intervention speed}_i$ <p>PSCi (without unit): calculated data (see calculation method p. 4). work rate_i (h/ha): Intervention speed i. Data entered by the user (he can also enter this work rate in ha/h).</p>
Tool combinations including a "Spreader & Accessories" tool	voy/h	$= (\text{PSCi} \times \text{product dose}) / (\text{intervention speed} \times \text{volume/trip})$ <p>PSCi (without unit): calculated data. Product dose (m³/ha, kg/ha or t/ha): Dose of "Fertiliser/organic amendment" type input for the intervention. Data entered by the user. Intervention speed (trip/h): Data entered by the user. Volume/trip (m³/trip, kg/trip or t/trip): Volume per trip of the combination of tools associated with the intervention, field filled in by the user.</p>
Tool combinations including a "Press" type tool	ball/h	$= (\text{PSCi} \times \text{bal/ha}) / (\text{intervention speed})$ <p>PSCi (without unit): calculated data. Bales/ha (bales/ha): Number of bales pressed per hectare by the combination of tools associated with the intervention. Data entered by the user. Intervention speed (bales/h): Data entered by the user.</p>

Implement combinations including a self-propelled "Apple Cider Harvesting" machine	t/h	= (PSCi x yield) / intervention speed PSCi (without unit): calculated data. Yield (t/ha): First 'main production' category yield expressed in t/ha defined in the Harvest action of the intervention. Data entered by the user. Intervention speed (t/h): Data entered by the user.
No tool combination entered	-	= 0

/!\ Entering the intervention speed for a combination of tools at the farm and intervention levels

The user can enter a value for the intervention speed for a combination of tools in the description of this combination in the Farm's equipment pool. A default value is proposed if available (source BCMA).

For each operation involving this combination of tools, its intervention speed, as entered in the Farm's equipment pool, is proposed by default. The user can modify this value for each operation.

If no intervention speed is declared, the time of use of the equipment defaults to 1 h/ha.

○ Manual work time

Preamble

As with the "time spent using the material", this indicator is calculated for the campaign and also for each month.

Presentation of the indicator

The manual work time is expressed in h/ha. It is calculated for manual interventions (i.e. that do not involve a combination of tools).

Calculation formula

Manual work time $_i$ =

$$PSC_i \times Intervention\ speed_i \times Number\ of\ person\ needed_i$$

Temps de travail manuel $_i$ (h/ha): Manual working time of the intervention i.

Number of person needed $_i$ (h/ha): Number of people involved in the intervention i. Data entered by the user.

PSC $_i$ (without unit): Proportion of area affected by the passage of the tool combination or manual operation of the intervention i. PSC_i is calculated on the basis of data entered by the user.

Intervention speed $_i$ (h/ha): of the intervention i. Data entered by the user.

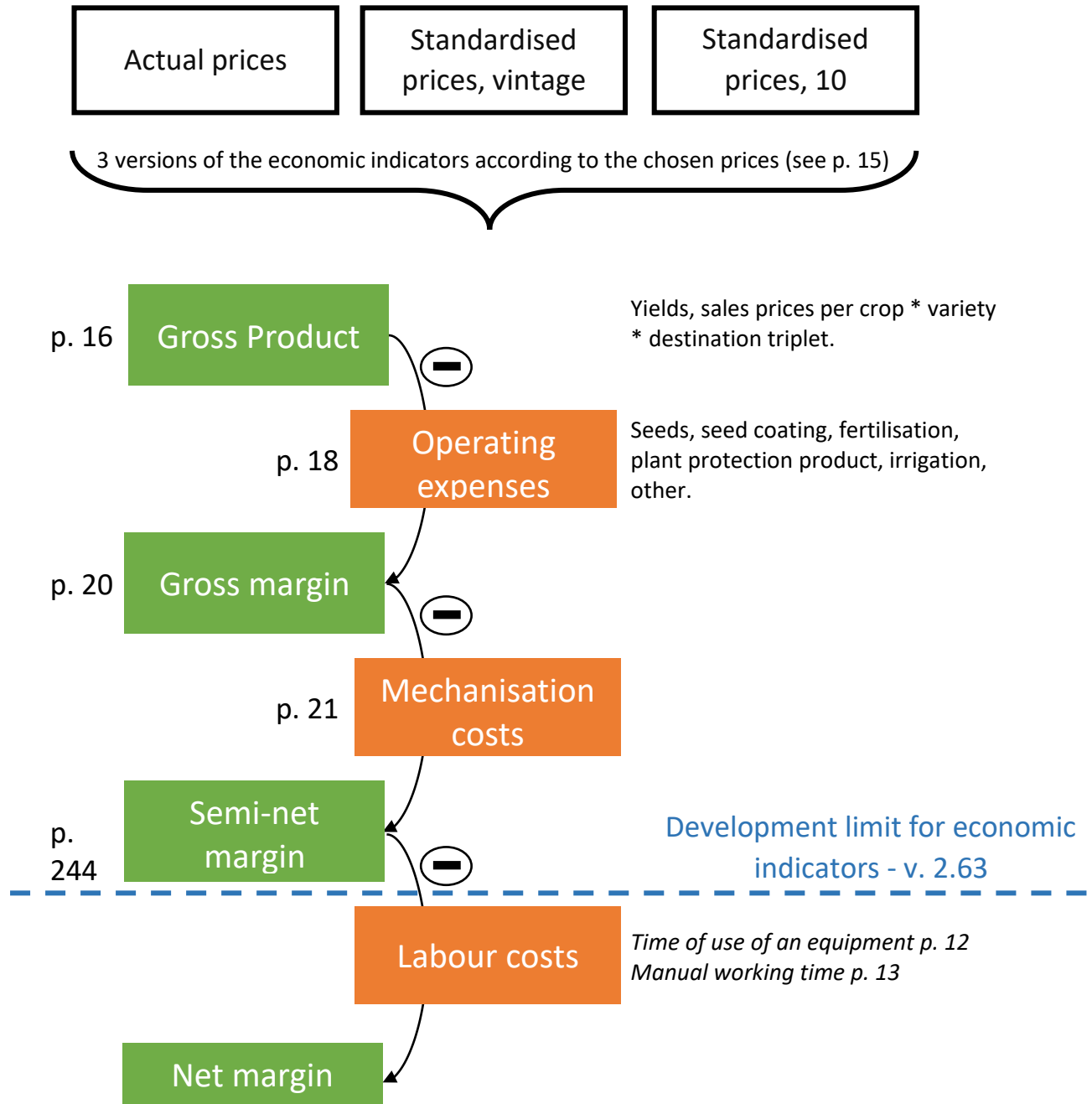
/!\ Missing field

If the "intervention speed" field is not filled in at the intervention level, the value declared at the farm level (equipment tab) in the description of the manual intervention is taken by default. If there is no value entered at farm level, **the manual work time is zero for this operation.**

By default, the value 1 is proposed for the data "Number of person needed" in the interventions. Indeed, only one person intervenes in most of the cultivation operations. Think of modifying this field if necessary.

⇒ Definition of economic performance indicators

○ Overview of economic indicators



○ Calculation of the different versions of the economic indicators

• Concerned indicators

Here are the different economic performance indicators calculated by Agrosyst (v. 2.56), expressed in euros per hectare (€/ha): gross product, operating expenses, mechanisation costs, gross margin and semi-net margin. The first three indicators can be calculated in several versions, each of them using different prices: 'real' prices entered by the user or prices from the reference systems contained in Agrosyst.

/!\ The mechanisation costs and the semi-net margin will also be calculated according to the three available versions in a later version of Agrosyst.

/!\ Labour costs and direct margin are not yet developed in Agrosyst (see 2.56).

• Calculation possibilities

Agrosyst contains several price frames for production costs (seeds, fuel and mechanisation costs, organic fertilisers, mineral fertilisers, plant protection and biological control products, irrigation) and sold products (in various forms, processed or not). All these price references (except for plant protection products) are by year. The period covered extends from 2000 to the year preceding the year of entry by the user.

The economic indicators mentioned in the previous section can be calculated with three different versions:

- **'Real Indicator'** version: Based on real prices, entered by the user. Otherwise, if the user has not entered any prices, the prices of the vintage reference frame are used.
- **'Standardised Indicator'** version **by year**: Based on standardised prices, present in the Agrosyst reference systems: depending on the campaign dates, the reference prices of the corresponding years are taken into account to calculate the performance indicators.
- **'Standardised Indicator'** version, **on scenarios**: from the benchmarks, 10 price scenarios were defined, representing contrasting years among the years covered by the benchmark.

No. Agrosyst Scenario	Year of harvest
01	2005
02	2007
03	2008
04	2009
05	2011
06	2013
07	2014
08	2015
09	2016
10	2017

In this case, regardless of the year declared for a campaign, the economic performance will be calculated from the reference prices of the year of the scenario considered.

/!\ The 10 scenarios defined and presented in the table are valid only for the arable field sector.

In addition to the work to complete and update the reference systems for all sectors, the scenarios could correspond to other campaigns for the other sectors.

When exporting performances, the first two modes of calculation of economic performance indicators are selected by default. The user can make a multiple choice for the Agrosyst scenarios, adding to the export file as many lines as the selected scenarios.

• Self-consumption of part of the harvest

For some cropping systems (e.g. mixed farming systems), part of the crops described in a cropping system can be consumed directly by the farm's livestock workshops.

The economic performance indicators (gross product, gross margin and semi-net margin as well as net margin in the future) are calculated in two different ways to take account of this characteristic of the farms to which these cropping systems belong:

- *Indicators with self-consumption*: the part of the crop consumed on the farm is considered to have been sold. This makes it possible to compare the economic performance of cropping systems that differ in their level of self-consumption.
- *Indicators without self-consumption*: only the part of the harvest that has been sold is used to calculate these indicators.

- **Price management in the case of a multi-year summary economic indicator.**

A cropping system can be declared over several cropping seasons, with the possibility for the user to declare a single price for inputs and outputs. The prices entered to obtain the **Real Indicators** must therefore be average prices for all the cropping seasons of this synthesised cropping system.

Similarly, it is the average of the reference prices for each crop year concerned that is used to calculate the **Standardised Indicators by year**.

○ Gross Product

Preamble

Two indicators are calculated here: the gross product taking into account self-consumption on the farm, and the gross product without self-consumption (only what has been sold).

Presentation of the indicator

The gross product is expressed in €/ha.

It corresponds to the income generated by the sale of products harvested during an intervention. It is calculated according to the data provided by the user in the Prices tab or thanks to the prices provided by the reference systems contained in Agrosyst (see *Calculation possibilities for economic indicators*). This indicator does not take into account the government aids.

As a reminder, two variants can be calculated:

- The actual gross product without self-consumption corresponds to the product generated solely by the sale of the harvested products. The part of the production consumed by the holding is not taken into account.
- The actual gross product with own consumption is the product from the sale of the harvested products and the product of the own consumption if it had been marketed.

The interventions concerned by this indicator are all interventions containing an action of type "Harvest".

Calculation formula

Gross product without self-consumption

$$\text{Gross product without selfconsum} = PSC_i \sum_{SQD} (Yield_{SQD} \times \text{Selling price}_{SQD} \times \% \text{ sold})$$

Gross product with own consumption

$$\text{Gross product with selfconsum} = PSC_i \sum_{SQD} (Yield_{SQD} \times \text{Selling price}_{SQD})$$

SQD: Species Qualifier*Destination combination* belonging to the list of species*qualifier*destination combinations for which a yield has been declared in intervention i. Each SQD combination is declined in two possible versions: one represents the reference price in conventional agriculture and one in organic agriculture.

/!\ The variety is not taken into account in the price reference

Examples:

Sector	Species	Qualifier	Destination
Arable field	Barley	2 rows	Grain, etc.
Outdoor Vegetable	Cabbage	Flower	All categories
Vineyard	Vine		Tank, Table
...			

Gross product without selfconsum (€.ha⁻¹): Real gross product without self-consumption for the main crop.

Gross product with selfconsum (€.ha⁻¹): Real gross product with self-consumption for the main crop.

PSC_i (without unit): Proportion of area affected by the passage of the tool combination or manual operation of intervention *i* containing an action of type 'Harvest'. *PSC_i* is calculated on the basis of data entered by the user.

Yield_{SQD} (several units): Reported yield for the SQD combination of the Harvest type action of the intervention *i*.

Selling price_{SQD} (several units): Sales price of the SQD combination. Data entered by the user.

/!\ Prices not entered by user

The user is assisted in entering prices in the interface. For each SQD combination, a price is displayed, which comes from the Production Prices repository.

If no price is entered by the user, this displayed price will be taken into account in the calculation of the indicator.

% sold (%): Share of the yield of the SQD combination sold. Data entered by the user.

% selfconsumed (%): Share of the yield of the SQD combination consumed by the user. Data entered by the user.

/!\ Declaration of 'Harvest' type interventions for the calculation of the Gross Product

The calculation of the gross proceeds is conditioned by the declared yield, but also by:

1. *the number of passes (or the spatial frequency in summary) of the intervention of the 'Harvest' type*: if a user declares a harvest made in several passes (or with a spatial frequency higher than 1), it is necessary to indicate the quantity harvested **per pass** (and not the total quantity).
2. *the number of interventions of type 'Harvest' in a technical itinerary*: if a user declares two interventions of type 'Harvest', one of which contains only one action of type 'Transport' or 'Other' to describe the conditioning actions of this harvest, the **gross product will be multiplied by 2**. To declare the interventions following the harvest, the intervention type 'Other' or 'Transport' must be used.

/!\ Consistency of the performance units of the S*Q*D combination and the reference price

Only one unit of output is possible for many S*Q*D combinations. In this case, the user must be careful to enter a real price in the same unit. For other combinations, several yield units are possible for the same S*Q*D combination, requiring to ensure (for the gross product and all the standardised indicators) that the reference price unit is the same as the yield unit.

In a future version of Agrosyst, a list of common conversion rates should allow the calculation of a correct gross product without having strictly the same unit of yield and price.

Reference data

Output price benchmarks. They are calculated from two elements:

- A production price benchmark provided by each sector for at least one year

- The producer price indices for agricultural products (IPPAP) calculated by INSEE, which allow the calculation of price series from a reference year: <https://www.insee.fr/fr/statistiques/series/109144301>

Note: for the wine industry, prices vary greatly between vineyards, including within the same appellation. There is therefore no production price benchmark.

○ Operating expenses

Presentation of the indicator

Operating expenses (or input costs) are expressed in €/ha.

They correspond to **expenses related to the purchase of inputs** (seeds and seedlings, mineral and organic fertilisers, seed coating, irrigation, plant protection products, biological control products, other inputs).

As a reminder, the calculation is based on the prices entered by the users, or on the prices entered in the Agrosyst reference systems (see *Calculation possibilities for economic indicators*).

The interventions concerned by this indicator are all interventions containing an input and/or a "Sowing" and/or an "Irrigation" action.

Calculation formula

$$OE_i = \left(PSC_i \sum_{SV} Q_{SV} \times PA_{SV} \right) + \left(PSC_i \sum_j Q_j \times PA_j \right) + \left(PSC_i \sum_e Q_e \times PA_e \right) + \left(PSC_i(phyto) \sum_k Q_k \times PA_k \right) + \left(PSC_i \sum_s Q_s \times PA_s \right) + \left(PSC_i \sum_p Q_p \times PA_p \right) + PSC_a \sum_a PA_a$$

OE_i (€/ha⁻¹) : operating expenses of the intervention i.

PSC_i (without unit): proportion of surface concerned by the passage of the tool combination or the manual operation of the intervention. PSC_i is calculated on the basis of data entered by the user.

PSC_a , (without unit): proportion of surface concerned by the passage of the combination of tools or the manual operation of the intervention. For 'Other' inputs, this value depends on the type of action within which this input is declared: $PSC_a = PSC_i$ or $PSC_i(phyto)$.

Sowing

Q_{SV} (various units): quantity sown of the Species*Variety (SV) pair, SV belonging to the list of SV pairs sown in the sowing action of intervention i. Data entered by the user.

PA_{SV} (various units): purchase price of the SV pair, SV belonging to the list of SV pairs sown during intervention i. Data entered by the user ('real indicator' version) or taken from the seed price repository ('standardised indicator, by year' or 'standardised indicator, on scenario' versions).

Mineral and organic fertilisation - Seed treatments

Q_j (various units): quantity of input j, j belonging to the list of inputs of type 'Seed treatments', 'Mineral (organo) fertiliser/amendment' or 'Organic fertiliser/amendment' applied during intervention i. Data entered by the user.

PA_j (various units): purchase price of input j, j belonging to the list of inputs of type "Seed treatments", "Mineral (organo) fertiliser/amendment" or "Organic fertiliser/amendment" applied during intervention i. Data entered by the user or taken from the mineral and organic fertilisers price references.

Irrigation

Q_e (various units): quantity of water declared in the action of type Irrigation during the intervention i. Data entered by the user.

PA_e (various units): purchase price of water. Data entered by the user or taken from the water price reference system. The cost of equipment is taken into account in the mechanisation costs.

Application of registered PPP (chemical and non-chemical) or Biocontrol and non-registered products

Q_k (various units): quantity of input k, k belonging to the list of inputs of type "Registered or not products" applied during intervention i. Data entered by the user.

PA_k (various units): purchase price of input k, k belonging to the list of "Registered or not products" type applied during intervention i. Data entered by the user or taken from the price reference system for those inputs.

Substrates

Q_s (various units): quantity of input s, s belonging to the list of inputs of type "Substrate" applied during the intervention i. Data entered by the user.

PA_s (various units): purchase price of the input s, s belonging to the list of inputs of type "Substrate" applied during the intervention i. Data entered by the user or taken from the substrate price repository.

Pots/Jars

Q_p (various units): quantity of input p, p belonging to the list of inputs of type "Pots/Jars" applied during intervention i. Data entered by the user.

PA_p (various units): purchase price of input p, p belonging to the list of inputs of type "Pots/Jars" applied during intervention i. Data entered by the user or taken from the pot price repository.

Other inputs

PA_a (€/ha): The user can enter a price for inputs of type "Other". However, there is no reference price for these types of inputs. The prices indicated for these inputs can only be entered in €/ha.

There is no quantity indicated in the formula for this type of input: the price entered by the user is considered as the loading level (quantity = 1).

/!\ Price entered in €/ha

In the same way as for 'Other' inputs, the user can enter a price in €/ha for all inputs. In this case, the price entered gives the level of charge directly.

/!\ Prices not entered by user

The user is assisted in entering prices in the interface. For each input, a price is displayed, which comes from the Input Costs repository. If no price is entered by the user, the price displayed will be the one taken into account in the calculation of the indicator (see *Calculation possibilities for economic indicators*).

Reference data

Cost benchmarks for the various inputs (sowing, mineral fertilisation, organic fertilisation, irrigation, plant protection products or biocontrol product, substrates and pots). In the same way as for the raw product benchmarks, two elements are used:

- Reference prices of the different inputs for at least one year,
- The purchase price indices for agricultural inputs (IPAMPA) calculated by INSEE, which allow the calculation of price series based on a reference year: <https://www.insee.fr/fr/statistiques/series/109144301>

Furthermore, for plant protection products, mineral fertilisers and organic fertilisers, reference prices are not known for all available commercial products. An additional step was necessary to calculate the missing prices:

- Fertiliser prices were determined according to the type of fertiliser and their composition in elements N, P, K (organic fertilisers) and N, P, K, B, Ca, Fe, Mn, Mo, Mg, S, Zn (mineral fertilisers).
- The prices of plant protection products were determined according to the type of treatment and the reference dose for the calculation of the TFI.

○ Gross margin

Presentation of the indicator

The gross margin is expressed in €/ha.

As a reminder, the calculation is based on the prices entered by the users, or on the prices entered in the Agrosyst reference systems (see *Calculation possibilities for economic indicators*).

It corresponds to the difference between the gross product of a crop and the operating expenses of that crop.

Two variants can be calculated:

- The **gross margin without self-consumption** taking into account the gross product without self-consumption;
- The **gross margin with self-consumption** taking into account the gross product with self-consumption.

Calculation formula

Gross margin without self-consumption

$$\text{Gross margin without selfconsum} = \text{Gross product without selfconsum} - OE$$

Gross margin with self-consumption

$$\text{Gross margin with selfconsum} = \text{Gross product with selfconsum} - OE$$

MB sans autoconso (€/ha): Gross margin without self-consumption of the main crop.

MB avec autoconso (€/ha): Gross margin with self-consumption of the main crop.

PB sans autoconso (€/ha): Gross product without self-consumption of the main crop (calculated data, see p. 16).

PB avec autoconso (€/ha): Gross product with self-consumption of the main crop (calculated data, see p. 16).

OE (€/ha): Operating expenses of the main crop interventions (calculated data, see p. 18).

Note: variability in the definitions of operating expenses, mechanisation costs, gross margin.

Depending on the definition, the cost of fuel is included or not in the operating expenses, and subtracted from the gross product to define the gross margin. In Agrosyst, the cost of fuel is not included in operating expenses but in mechanisation expenses.

○ Fuel consumption

Presentation of the indicator

The fuel consumption of an intervention is expressed in l/ha. It corresponds to the quantity of fuel used during a cultivation operation. In addition to the description of the equipment and the associated references of the BCMA, the calculation of this indicator involves another indicator: the *time of use of the equipment* (see p. 12).

The interventions covered by this indicator are all **interventions that use a combination of tools**.

The calculated fuel consumption is part of the mechanisation costs (presented after this indicator).

Calculation formula

$$\text{Fuel consum.}_i = \text{Time of use of the equipment}_i \times \text{Power} \times \text{Loading rate} \times \text{Consumption}_{ref}$$

*Fuel consum.*_i (l/ha): Fuel consumption of the intervention i.

Time of use of the equipment t_i (h/ha): Working time of intervention i , calculated data (see page 12).

Power (hp): Power of the self-propelled vehicle or tractor used in the combination of tools associated with the operation i . Data taken from the BCMA equipment reference system.

Loading rate (unitless): loading rate of the tool combination associated with the intervention i .

- Among the load rates of each component of the combination of implements (tractor, implement, self-propelled), the highest value should be taken. Data taken from the BCMA equipment reference (column "Engine load rate data").
- For irrigation interventions, the load rate is always 0 (and therefore the fuel consumption as well).

Consumption_ref (L/hp/h): reference fuel consumption per horse per hour at 100% load (BCMA). Two values are possible depending on the power of the self-propelled vehicle or tractor:

- 0.24 L/hp for tractors and self-propelled vehicles up to 130 hp.
- 0.21 L/hp for tractors and self-propelled vehicles with a power output of more than 130 hp.

/!\ Missing field

If one of the fields of the formula is not filled in the BCMA repository, then the indicator is not calculated.

Reference data

The reference data used in the calculation of fuel consumption are:

- **the power of the tractor or self-propelled vehicle** (BCMA);
- **the tool combination loading rate** (BCMA). Note that the loading rate is expressed either in % or directly without unit.

o Mechanisation costs

Presentation of the indicator

The real mechanisation costs of an intervention are expressed in €/ha. The interventions concerned by this indicator are those that mobilise a **combination of tools**.

The real mechanisation costs correspond to fixed costs (depreciation of equipment) and variable costs (**fuel consumption, repairs, lubrication, tyre maintenance**). Mechanisation costs are calculated according to the "BCMA" method, which is the current APCA Agroéquipement Office. They do not include labour costs.

Mechanisation costs take into account the **equipment declared by the user** for each intervention, the **level of equipment use** and whether or not this equipment belongs to a cooperative or subcontractor.

/!\ The mechanisation costs are only calculated in the real version for the moment!

The 'standardised' versions of this indicator are not yet developed.

Calculation formula

$$MC_i = Fuel\ cost_i + PSC_i \times [Fixed\ MC_i + Repair\ costs_i + Tyres\ costs_i + Oil\ cost_i]$$

1. Calculating the cost of fuel

$$Fuel\ cost_i = Fuel\ consumption_i \times Price_{fuel}$$

Fuel consumption_i (l/ha): Indicator calculated in the exported performance and presented after the mechanisation costs (p. 2120).

Note: The calculation of fuel consumption (l/ha) already includes the Proportion of area involved in intervention i (PSC_i), as this consumption is calculated from the time the equipment is used (see p. 7). For this reason, it is the only component of mechanisation costs that is not multiplied by the PSC_i .

$Price_{Fuel}$ (€/l) : Purchase price of fuel.

2. Real fixed costs - intervention scale - unit €/ha

$$fixed MC_i = \sum_m \frac{Purchase\ price_m \times 0,01 \times Global\ rate_m}{Use_m}$$

m: equipment belonging to the list of equipment (traction, tools, self-propelled, irrigation) of the combination of tools used in the intervention i.

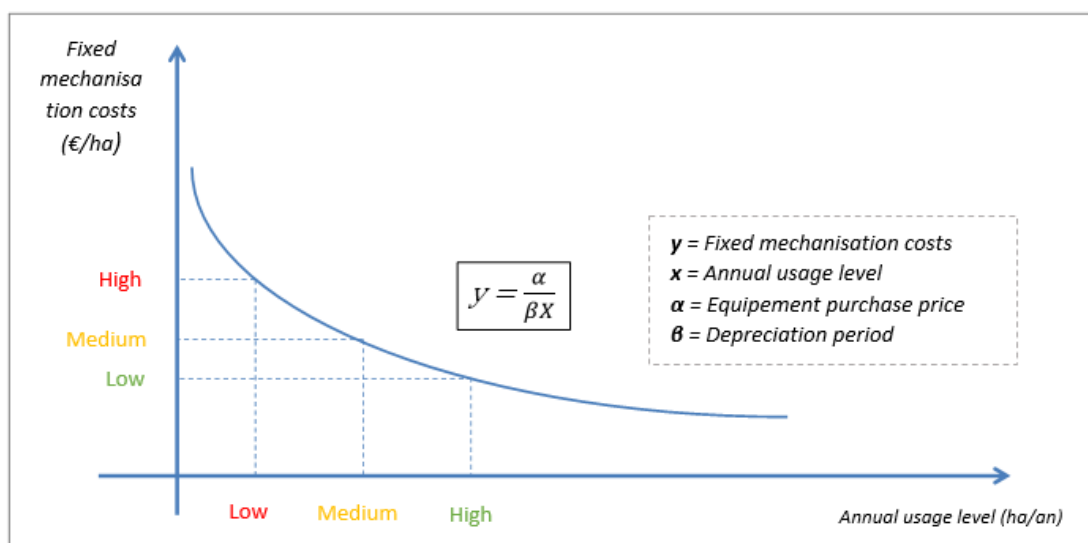
$Purchase\ price_m$ (€) : Purchase price of equipment m. Data taken from the Equipment reference frame.

$Global\ rate_m$ (%): Annual depreciation rate of the equipment m integrating the depreciation period, the depreciation rate, the interest, the storage and insurance costs. This rate is provided in a table produced by the APCA-Bureau Agroéquipement. The value of $Global\ rate_m$ is chosen according to the type of equipment. As this rate is expressed in %, it is necessary to multiply it by 0.01 to calculate the real fixed costs.

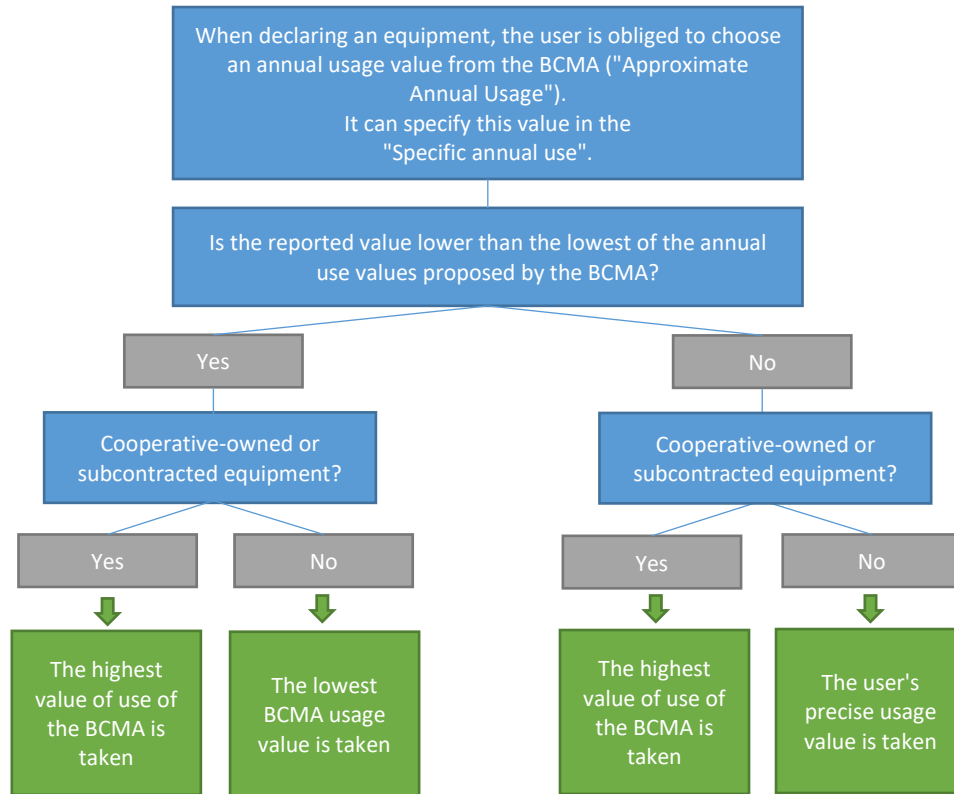
Use_m (ha/year): Annual use of equipment m. In the case where a use is declared in another unit (in h/year for example), a conversion is carried out using the work rate entered. Data entered by the user in the description of the Farm's equipment. If the precise annual use is not provided, a default value is used (see "Approximate annual use" field).

/!\ What value should be taken for the annual use of the equipment?

For each piece of equipment, the user must declare a level of use at the estate level. This level of use influences the calculation of mechanisation costs. Indeed, the less the equipment is used over its depreciation period, the higher the cost of the passage per hectare.



The user can choose among 3 annual use values proposed by the BCMA. The user can then refine this value by declaring an estimated value with the farmer, **in the same unit as that proposed by the BCMA**. The rules for defining the annual utilisation value used in the calculation of mechanisation costs would then be as follows:



- With this method, it is always considered the cooperative-owned or subcontracted equipment used has the highest value of annual use proposed by the BCMA, which makes its passage cost low.
- If the equipment is not a cooperative-owned or subcontracted equipment, and if the annual use value of the equipment declared by the user **is lower than the lowest of the values proposed by the BCMA**, the lowest of the values proposed by the BCMA will still be used. This will ensure that the cost of switching is not overestimated.

3. Repair costs

$$Repair\ costs_i = \sum_m Repair\ costs_m$$

Repair costs_m (€/ha): repair costs of the equipment *m*, *m* belonging to the list of equipment (traction, tools, self-propelled equipment, irrigation) of the combination of tools used in the intervention *i*. Lump sum (€/ha) corresponding to equipment maintenance costs (e.g. wear and tear on tines, tyres, breakage of safety bolts, cost of oil for changing self-propelled equipment). Data taken from the BCMA equipment reference system.

4. Tyres costs

$$Tyres\ costs_i = \sum_m Tyres\ costs_m$$

Tyres costs_m (€/ha): tyre replacement costs for equipment *m* (only tractors and self-propelled machines, *a priori* there is only one equipment concerned for a given intervention) of the combination of tools used in intervention *i*, provided by the "Equipment (BCMA): Traction" and "Equipment (BCMA): Self-propelled machines" reference systems

5. Oil use costs

$$Oil\ costs_i = \sum_m Oil\ costs_m$$

Oil costs_m (€/ha): lubricant costs of the equipment m (only tractors and self-propelled machines) of the combination of tools used in the intervention i. Data from the "Equipment (BCMA) Traction" and "Equipment (BCMA): Self-propelled" reference systems.

Reference data

BCMA standards (traction, tools, self-propelled vehicles, irrigation)

Reference fuel price

○ Semi-net margin

Presentation of the indicator

The semi-net margin is expressed in €/ha. It is calculated at the crop level.

It is the difference between the gross margin of a crop and the mechanisation costs of that crop.

Two variants can be calculated:

- The **semi-net margin without self-consumption** taking into account the gross margin without self-consumption;
- The **semi-net margin with self-consumption** taking into account the gross margin with self-consumption.

/!\ The semi-net margin is only calculated in the real version for the moment!

The standardised and vintage standardised versions of this indicator are not yet developed.

Calculation formula

Semi-net margin without self-consumption (SNM without selfconsum)

$$SNM \text{ without selfconsum} = \text{Gross margin without selfconsum} - \text{Mechanisation costs}$$

Semi-net margin with self-consumption

$$SNM \text{ without selfconsum} = \text{Gross margin with selfconsum} - \text{Mechanisation costs}$$

Gross margin (€/ha): calculated data (see definition p. 20)

Mechanisation costs (€/ha): calculated (see definition on p. 21).

Reference data

No reference data for this calculation.