SciCom

SCIENTIFIC COMMITTEE
of the Belgian Federal Agency for the Safety of the Food Chain

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Subject:

Revision of the plant health barometer

(SciCom 2014/12C)

Scientific opinion approved by the Scientific Committee on 20 April 2018.

Key terms:
Barometer, plant health, indicators

Sleutelwoorden:
Barometer, plantengezondheid, indicatoren

Mots-clés:
Baromètre, santé végétale, indicateurs

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The plant health barometer was developed in 2011 as a tool to present, to both consumers and the food chain sectors, a clear picture of the state and change of the plant health in Belgium. The current barometer (barometer version 1.0) is based on a basket of 13 plant health indicators (PHIs) for which data were gathered from 2007 on. Following a SWOT analysis (identification of strengths, weaknesses, opportunities & threats) of the barometer in 2013 indicating a number of issues for improvement, the Scientific Committee has been asked to reevaluate the concept of the barometer on a scientific basis.

More specifically, the following questions have been raised:

i. Are the current indicators still relevant?
ii. How to deal with indicators whose interpretation is open to debate?
iii. Should new indicators be included?
iv. Is a new weighting of the indicators required?
v. Should the current scale definition be maintained?
vi. Is a trend analysis based on the barometer results possible?

Methodology

The basket of plant health indicators on which the barometer is based, as well as the approach followed for 'measuring' the plant health state are revised based on information available from scientific literature and reports, on expert opinion and on data provided by the Belgian Federal Agency for the Safety of the Food Chain (FASFC). The Opinion of the Scientific Committee has been provisionally approved on 13 January 2017 and then submitted for an open consultation to the members of the Advisory Committee of the FASFC and to specific stakeholder groups.

Discussion

Based on a number of criteria, such as current relevance and consistency between changes observed in terms of collected data and in terms of (biological) evolution, the basket of 13 plant health indicators (PHIs) was re-examined. This resulted in a new basket of 11 PHIs, including some of the original PHIs but also a number of newly defined PHIs. Similarly to the previous indicator basket, the new basket proposed contains PHIs related to the preventive approach (self-checking, notifications, traceability) and to the control of plant/plant products (on the presence of plant harmful organisms). In compiling the basket, the aim was to include as representatively as possible the various categories of plant health hazards and the various aspects of the plant production chain. In general, preference was given to indicators with a larger scope regarding hazards, matrices and/or sectors considered. An overview of the indicators kept, changed, or newly defined together with a short argumentation is given in attachment. For each of the 11 PHIs selected, more detailed information is given in technical sheets, also available in the appendix.

Two approaches are proposed for representing the plant health state, based on the new basket of 11 PHIs.

The first approach, barometer version 2.1, is similar to the approach applied for the barometer's original version (version 1.0). The plant health state is expressed as the average of the differences in terms of percentage between the results of the PHIs for two successive years. In this Opinion, the plant health state of 2011, 2012, 2013, 2014 and 2015 is calculated accordingly, based on the new basket of 11 PHIs.

The second approach, barometer version 2.2, concerns a measurement of the plant health state compared to predefined objectives. The plant health state is expressed as the average of the

differences, compared to the improvement potential (IP) of each PHI and expressed in terms of percentage, between the results of the PHIs of a given $year_x$ and the median result of previous years of each PHI. Indeed, given that for some PHIs there is still a large margin of improvement, whereas for others reported results are already (relatively) close to the predefined objective, the indicator results are expressed compared to a (theoretical) IP. This IP, being the difference between the objective and the median result of previous years of the PHI, is introduced to scale the divergent margins of improvement for the different PHIs. The time frame considered for determining the median PHI result can be a fixed period in time (static) or a moving X-year window (dynamic). A moving X-year window allows more flexibility in the tool (amongst others, the trend of the indicator results is accounted for and objectives can be linked to e.g. the 'Multi Annual National Control Plan' or MANCP cycle). However, for the purpose of evaluating the change of the indicators towards their predefined objective, the X-year timeframe considered should be sufficiently long and the predefined objectives should also be fixed over a sufficiently long period of time. This second approach or barometer version 2.2 is illustrated in the Opinion with respect to the plant health state of 2014 and 2015, based on the new basket of 11 PHIs.

Answer to the questions

(i) Are the current indicators still relevant?

As mentioned in SciCom Opinion 10-2011 (SciCom, 2011b), the composition of the basket of indicators may be adapted periodically. Given that the barometer version 1.0 already covers a large period (composed in 2010 with data going back to 2007), the original indicator basket was evaluated according to a number of criteria (see 5). This resulted in a new basket containing 11 PHIs, which were evaluated in terms of their relevance, acceptability, credibility, easiness to monitor and robustness (i.e. RACER criteria in Appendix 4: RACER criteria applied to the plant health indicators. & technical sheets in Appendix 3: Detailed technical sheets of the plant health indicators.). An overview of the indicators deleted, kept, changed, or newly defined together with a short justification is given in Appendix 2: Overview of plant health indicators deleted, kept, changed or newly defined..

(ii) How to deal with indicators whose interpretation is open to debate?

The indicator related to the number of mandatory notifications received yearly by the FASFC with regards to the detection of plant diseases and plant harmful organisms (PHI01) has been kept but its interpretation was reversed compared to plant health barometer version 1.0 (see 5). More notifications is now interpreted as a deterioration of the state and not more as an indication of increased awareness of the sector.

(iii) Should new indicators be included?

A number of new indicators are proposed to be included into the barometers versions 2.1 and 2.2 (see 5), some of them replacing previous indicators.

(iv) Is a new weighting of the indicators required?

A new weighting of the PHIs, in function of their direct relationship to plant health as perceived by various stakeholders in the plant production chain, is not a prerequisite, but is recommended. Moreover, inclusion of such an assessment of the relative importance of the PHIs on plant health was identified as one of the strengths in the SWOT analysis (see Appendix 1: Summary of the results of the SWOT analysis of the barometers.).

(v) Should the current scale definition (barometer version 1.0) be maintained?

The difficulty remains that plant health cannot be expressed in absolute values (see SWOT analysis, Appendix 1: Summary of the results of the SWOT analysis of the barometers.). Given the straightforward approach of barometer version 1.0, it was decided to maintain the current scale definition. Besides the scale definition of barometer version 1.0 applied to the new set of PHIs (i.e. barometer version 2.1), an alternative scale definition based on a measurement compared to predefined objectives (i.e. barometer version 2.2) is nonetheless proposed. The two scales can be used in a complementary way (see 6).

(vi) Is a trend analysis based on the barometer results possible?

The 'analysis', or rather the 'observation' of trends is possible and comes down to what can be visually observed from the barometer results over time. Whereas the final barometer result is used as a first line of communication, the actual evaluation of the plant health state is based on the individual indicator results. The primary goal of the barometer is to measure the overall plant health state and change, on the basis of indicators that are related to monitoring and ensuring of plant health throughout the entire plant production chain, and not to conduct a comprehensive plant health assessment (SciCom, 2011b).

Conclusions

The plant health barometer version 1.0 (= current version) has been revised. The original basket of 13 plant health indicators has been reduced to 11 indicators.

Based on this new basket, two approaches are proposed and illustrated for presenting the plant health state, namely (i) as a measurement in terms of a relative change of state between two consecutive years (i.e. version 2.1, with a similar approach to that used in version 1.0), and (ii) as a measurement compared to predefined objectives (i.e. version 2.2, with a new approach as used in version 1.0). In this sense, both approaches complement each other since the first approach or barometer version 2.1 is rather a communication tool, whereas the second approach or barometer version 2.2 is a more policy-orientation instrument.

The current Opinion concerns the scientific evaluation of the concept of the plant health barometer. Although the Scientific Committee proposed a methodology of approach, it is up to the FASFC to turn the concept into reality, amongst others with respect to the predefined objectives, the chosen window of comparison, etc. Additional refinement of the barometer versions might consist of a weighting of the indicators according to their direct relationship to plant health as perceived by various stakeholders in the plant production chain.

1. Terms of reference

1.1. Questions

The 3 barometers for the safety of the food chain (i.e. the food safety barometer, the animal health barometer and the plant health barometer) have been in use since 2010. They made it possible to get an overall view of the change of the safety of the food chain since 2007 (http://www.favv.be/scientificcommittee/barometer/). Given that the barometers already cover a period of many years, the Scientific Committee has been asked to evaluate the concept of the barometers on a scientific basis.

The following specific questions have been raised:

i. Are the current indicators still relevant?
ii. How to deal with the indicators whose interpretation is open to debate?
iii. Should new indicators be included?
iv. Is a new weighting of the indicators required?
v. Should the current scale definition be maintained?
vi. Is a trend analysis based on the barometer results possible?

1.2. Methodology

This Opinion is based on evidence from scientific literature and reports, on expert opinion and on data provided by the Belgian Federal Agency for the Safety of the Food Chain (FASFC). The Opinion of the Scientific Committee has been provisionally approved on 13 January 2017 and then submitted for an open consultation to the members of the Advisory Committee of the FASFC and to specific stakeholder groups.

2. Definitions and abbreviations

BIP	Border Inspection Posts.
EPPO	European and Mediterranean Plant Protection Organization.
FASFC	Belgian Federal Agency for the Safety of the Food Chain.
Indicator	A measure for rendering and analyzing certain problems or issues. An indicator synthesizes or simplifies relevant data about the state or change of a number of phenomena or symptoms. An indicator represents a reality that is in itself not entirely perceptible. It is an instrument that is intended for communication and support in the decision making process, and it can assume either a quantitative (cardinal) form or a qualitative (nominal or ordinal) form (SciCom, 2010).
IP	Improvement potential; the difference between the indicator objective and the median of the indicator results obtained during previous years.
PHI	Plant health indicator.
SciCom	Scientific Committee of the FASFC.
SCS	Self-checking system, i.e. a food safety management system based on good working practices and HACCP (Hazard Analysis of Critical Control Points), http://www.favv.be/autocontrole-en/default.asp. In the primary production sector, self-checking pertains to compliance with hygiene requirements and keeping the necessary registers.
SWOT	(Analysis of) Strengths, weaknesses, opportunities and threats.

Considering the discussions during the work group meetings on 20/06/2014, 13/11/2014, 27/02/2015, 04/05/2015, 29/02/2016 and during the plenary sessions of the Scientific Committee on 21/02/2014, 21/11/2014, 27/02/2015, 27/03/2015, 18/03/2016, 18/11/2016, 13/01/2017 and 20/04/2018 as well as the open consultation which took place from 19/06/2017 until 15/09/2017,

the Scientific Committee gives the following scientific opinion:

3. Introduction

The barometer of safety of the food chain is an instrument, developed by the Scientific Committee (SciCom) of the Belgian Federal Agency for the Safety of the Food Chain (FASFC), allowing annual provision of the general image of the safety state of food chain in Belgium (SciCom, 2010). In order to get a view of the safety of the entire food chain (from farm to fork), food safety as well as animal and plant health are considered. Given that the state of these 3 sub-areas may differ significantly and that they are not always interrelated and concern other stakeholders, it was chosen to measure their state separately by means of 3 different barometers, namely the food safety barometer (SciCom, 2010), the animal health barometer (SciCom, 2011a) and the plant health (phytosanitary situation) barometer (SciCom, 2011b). The barometers results are published in the FASFC's annual reports and are available on the FASFC's website (http://www.favv.be/scientificcommittee/barometer/).

The current Opinion specifically concerns the plant health barometer.

The plant health barometer version 1.0 (= current version) consists of a basket of 13 carefully chosen, measurable indicators (plant health indicators or PHI) which together reflect the plant health (phytosanitary) state (SciCom, 2011b). These indicators concern all links of the plant production chain, namely suppliers, primary production, distribution/trade, propagating of plants, processing of plants (e.g. wood packaging materials, cut flowers), forests and green spaces, as well as various types of plants and plant products, namely fruits, vegetables, potatoes, cereals, ornamental plants (including trees), plants/seeds, cut flowers and wood packaging. They are related to a preventive approach (self-checking, mandatory notifications, traceability) and to plants/plant products controls (presence/absence of quarantine plant pests and pathogens). The majority of the indicators are measured within the context of the control program of the FASFC, allowing a simple annual monitoring (SciCom, 2011b).

Given the different impacts of the 13 indicators upon plant health, their relative importance was weighted by the various stakeholders of the food chain, i.e. risk managers, the Advisory Committee (including representatives of other public administrations and of the various sector and consumer organizations) and the Scientific Committee of the FASFC (SciCom, 2012).

Based on the difference between the results of the plant health indicators for two successive years, the average of these differences in terms of percentage, taking into account the relative importance of each indicator, gives the final value of the barometer. The result of the barometer is expressed by comparing the current state with that of previous year as it is difficult to express plant health in absolute terms, since plant health depends, among other things, on standards or action limits defined on a policy-level and liable to changes.

Given that the barometers already cover a period of several years, the Scientific Committee has been asked to evaluate the concept of the barometer. As a first step in this evaluation, the strengths,

weaknesses, opportunities and threats (SWOTs) of the barometers have been identified in order to examine to what extent the barometers meet the needs of the stakeholders and to determine in which direction they should evolve.

4. SWOT analysis of the barometers *(barometers version 1.0)*

A SWOT analysis of the barometers was performed by members of the Scientific Committee and FASFC risk managers in 2013. The main results of this analysis are summarized in Appendix 1: Summary of the results of the SWOT analysis of the barometers..

The analysis showed that the barometers are powerful instruments for presenting the change of the safety state of the food chain in a simple way. However, there are some aspects requiring improvement, both in terms of communication (such as raising awareness among consumers and operators, interpretation of the barometers results) and regarding the concept itself (including relevance and interpretation of some indicators, weighting of indicators, scale definition of the barometers results).

5. Basket of plant health indicators

A plant health indicator (PHI) is defined as an indicator that provides broad-scoped information regarding the overall plant health state. A PHI is not a performance indicator, in the sense that it is not designed for evaluating the performance level of a certain (set of) activity(ies), as is often done in a management context where the goals have been clearly set. The term "plant health indicator" does not necessarily give an appreciation of the actual performance level with regard to any given activity (SciCom, 2011b). Based on measurements obtained through a limited number of selected indicators which relate to the respective hazards and partial aspects of plant health within the plant production chain, and which, as a whole, provide a representative image of the actual state, the plant health barometer thus gives an indication of the plant health state.

It is not the intention of the barometer or of the set of selected indicators to give an exact image of the presence and status of all potential hazards within the plant production chain, nor to carry out any form of risk assessment.

The current plant health barometer (barometer version 1.0) is based on a basket of 13 PHIs. From 2007 on, data have been gathered for the 13 PHIs. These PHIs have been evaluated according to the following four criteria:

1. Change; how did the indicator change over the last years?
2. External validation/'biological' evaluation; is the observed tendency consistent with the (biological) evolution experienced or perceived in the field?
3. Is the indicator still relevant?
4. Is it possible/is it a necessity to define a new indicator?

Additionally, the possibility of defining an objective for every indicator was looked at, and this in view of an alternative approach for measuring the plant health state (see 6.2).

During the second step of the revision process of barometer version 1.0., each previously defined indicator was reviewed. An overview of the indicators deleted, kept, changed, or newly defined together with a short justification is given in Appendix 2: Overview of plant health indicators deleted, kept, changed or newly defined.. Generally, it is chosen to have broader indicators with

respect to hazards, matrices and/or sectors considered compared to the indicator basket of barometer version 1.0. The purpose of this extension is to give a fuller picture of the plant health state. So, the seven specific indicators (in version 1.0) about compliance of samples taken to check the absence of specific quarantine plant pests and pathogens are now replaced by five more generic indicators on compliance of samples taken to check the absence of all the regulated plant pests and pathogens distributed by type of harmful organisms (fungi, viruses/viroids, insects, nematodes and bacteria). Furthermore, the new barometer is no more limited to quarantine organisms but takes also into account emerging plant pests/pathogens. The new PHI03 on first report/first detection of plant harmful organisms in Belgium can indeed deal with harmful organisms which are included on the European and Mediterranean Plant Protection Organization (EPPO) Alert List but which do not have a quarantine status yet.

Table 1 gives an overview of the new PHIs basket. The following two categories of indicators can be distinguished:

i. indicators related to the preventive approach, and
ii. indicators related to the control of plants/plant products.

For each PHI, a detailed technical sheet is available (Appendix 3: Detailed technical sheets of the plant health indicators.). Each indicator is discussed in terms of the RACER criteria. RACER stands for "relevant, accepted, credible, easy to monitor and robust" (MANCP, 2015). More explanation on the RACER criteria as applied to PHIs is given in Appendix 4: RACER criteria applied to the plant health indicators.. From the technical sheets, it is clear that each indicator has its own possibilities and limitations.

Table 1. Overview of the new plant health indicators (PHI)

Name		Description
Preventive approach		
PHI01	Mandatory notification of plant diseases and plant harmful organisms	The number of notifications received by the FASFC each year with regards to the detection of plant diseases and plant harmful organisms (excluding official control plan).
PHI02	Self-checking for plant production	The percentage of activities performed with a validated/certified self-checking system (SCS) in the plant production sector.
PHI03	Annual number of 'first report/first detection' of plant harmful organisms in Belgium	The annual number of 'first report/first detection' of plant harmful organisms in Belgium according to the EPPO Reporting Service articles (https://gd.eppo.int/country/BE/reporting), to *Plant Disease* and to *European Journal of Plant Pathology*.
PHI04	Phytosanitary inspections (traceability)	The percentage of annual phytosanitary inspections relating to traceability in the plant production sector that were deemed to be 'favorable' or 'favorable, subject to remarks'.
Control of plants/plant products		
PHI05	Plant harmful organisms regulated and detected in Belgium	The percentage of regulated plant harmful organisms for which at least one sample is tested positive per year in Belgium in relation to the

		total number of regulated plant harmful organisms.
PHI06	Phytosanitary import controls	The percentage of samples of plant and plant product consignments, imported into the EU via the Belgian border inspection posts (BIP), which are compliant with the plant health requirements.
PHI07	Regulated phytopathogenic viruses and viroids controls	The annual percentage of compliant samples tested for regulated phytopathogenic viruses and viroids within the framework of the FASFC control plan.
PHI08	Regulated phytopathogenic bacteria controls	The annual percentage of compliant samples tested for regulated phytopathogenic bacteria within the framework of the FASFC control plan.
PHI09	Regulated phytopathogenic fungi controls	The annual percentage of compliant samples tested for regulated phytopathogenic fungi within the framework of the FASFC control plan.
PHI10	Regulated phytophagous or xylophagous insects controls	The annual percentage of compliant samples tested for regulated phytophagous or xylophagous insects within the framework of the FASFC control plan.
PHI11	Regulated phytophagous or xylophagous nematodes controls	The annual percentage of compliant samples tested for regulated phytophagous or xylophagous nematodes within the framework of the FASFC control plan.

6. Calculation of plant health state

During the third step of the revision process of barometer version 1.0., two approaches were proposed for calculating the plant health state, namely (i) as a measurement in terms of a change of the state compared to the previous year (i.e. informative instrument), as previously in the barometer version 1.0, and (ii) as a measurement compared to predefined objectives (i.e. more a policy-orientation instrument), as new compared to barometer version 1.0.

6.1. Measurement in terms of change (Barometer version 2.1)

Similarly to barometer version 1.0, the final result of barometer version 2.1 (i.e. the plant health state) is calculated as the average of the difference in terms of percentage between the results of the indicators for two successive years (see eq. 6.1.1. & 6.1.2.).

$$Barometer\ 2.1\ year_x = \frac{\sum_{i=1}^{n} result\ indicator_i}{n} \quad \text{(eq. 6.1.1.)}$$

with

n = number of indicators

$$Result\ indicator_i = \left[\frac{result\ year_x - result\ year_{(x-1)}}{result\ year_{(x-1)}}\right] x\ 100\% \quad \text{(eq. 6.1.2.)}$$

It is noteworthy that the sign of the indicator result is reversed when an increase corresponds to a deterioration of the plant health state. This is the case for the indicators related to the mandatory

notification of plant diseases and plant harmful organisms (PHI01), to the annual number of 'first report/first detection' of plant harmful organisms in Belgium (PHI03) and to the plant harmful organisms regulated and detected in Belgium (PHI05).

Advantages of this approach are that it is straightforward, and that the expression of the state in relative terms (and not as an absolute figure) allows anticipating potential changes e.g. regarding action limits, at policy level or pressures on the plant production chain. The approach is essentially descriptive in nature.

In this respect, the principal objective of barometer version 2.1 is to communicate in a simple way about the plant health state. It can be used for the observation of long term trends both as regarding the individual indicators and the barometer itself (across all indicators).

6.2. Measurement compared to (proposed) predefined objectives (Barometer version 2.2)

In the previous Opinion regarding the development of the barometer version 1.0 (SciCom, 2011b), it was concluded that policy goals regarding plant health (phytosanitary situation) are not quantitatively defined, neither in national documents, nor in European documents, but if more measurable goals would be available for specific points of interest, a further objective assessment with regard to the plant health state would be simplified.

In what follows, an approach is put forward for measuring the plant health state in relation to (proposed) predefined objectives.

6.2.1. Defining the objectives

For each indicator, an ambitious objective is proposed (see technical sheets in Appendix 3: Detailed technical sheets of the plant health indicators.). For example, for indicators related to the control of plants/plant products (except for PHI05), the final goal is set at 100% compliance. It is noteworthy that 100% compliance is not strictly 100% when taking uncertainty into account (i.e. 0% risk does not exist). Furthermore the aim of the FASFC control plan is to detect, with a certain confidence level (between 90 and 99%, depending on the risk), the non-compliant results exceeding a predefined prevalence level (Maudoux et al., 2006).

For the purpose of evaluating the change of the indicators towards their predefined objective, the objectives have to remain fixed over a sufficiently long period of time (e.g. for 6 years).

Not reaching an objective should indicate that more actions are needed by the authorities and/or stakeholders (e.g. more controls and/or better support of or communication to the stakeholders) and does not necessarily indicate a problem resulting in a risk for plant health. Additionally, it is emphasized that the plant health indicators are not performance indicators used for evaluating the performance level of a certain (set of) activities (see definition, 5). Measuring the plant health state compared to predefined objectives has a signal function for areas of improvement and does not concern an appraisal of achievements or the functioning of food safety policy given that different stakeholders are involved.

6.2.2. Defining the 'improvement potential'

When considering the difference between the indicator result and the indicator objective in absolute terms, some indicators have to bridge a higher margin for reaching the objective in comparison with

other indicators which show already each year a high level of compliance (above 95%) and consequently have a lower margin of improvement.

To level out this difference, the result of each indicator is expressed compared to a (theoretical) improvement potential (IP, see eq. 6.2.2.). The IP is defined as the difference between the objective and the median of the results obtained during previous years (see eq. 6.2.3.) and should be viewed as a reference point for comparing results. The time frame considered for calculating this median can be 'static', i.e. a fixed period of X years, or 'dynamic', i.e. an 'X-year moving window' (e.g. 6 years, i.e. 2 business plan cycles). In this way, the already documented information, as well as the trend in indicator results are taken into account. A consequence of a 'moving window' is that, at a certain point in time, results for a given year will no longer be considered for the barometers and that the median represents only the recent state of each indicator. Moreover, if a positive trend in the state is observed (via barometer version 2.1), it might become more difficult to bridge the margin of improvement. Since a positive trend implies an increase of the median value, barometer version 2.2 results might become less positive. Additionally, the use of a 'moving window' can be argued for, because changes in pressure on the plant production chain might impact the plant health state (e.g. globalization, climate change, legislation). Moreover, it makes it possible to link objectives laid down in advance by policy with indicators to be followed during e.g. an MANCP (Multi Annual National Control Plan) cycle (see 'opportunities' SWOT, Appendix 1: Summary of the results of the SWOT analysis of the barometers.). Similarly as remarked for the objectives, the window or timeframe considered should cover a sufficiently long period in order to be able to evaluate trends in the indicators towards their predefined objective.

6.2.3. Measuring compared to the improvement potential

The final result of barometer version 2.2 (i.e. the plant health state) is expressed as the average of the differences, compared to the improvement potential (IP) of each PHI and expressed in terms of percentage, between the results of the PHIs of a given $year_x$ and the median result of previous years of each PHI or of a given timeframe (eq. 6.2.1.).

$$Barometer\ 2.2\ year_x = \frac{\sum_{i=1}^{n} result\ indicator_i}{n} \quad \text{(eq. 6.2.1.)}$$

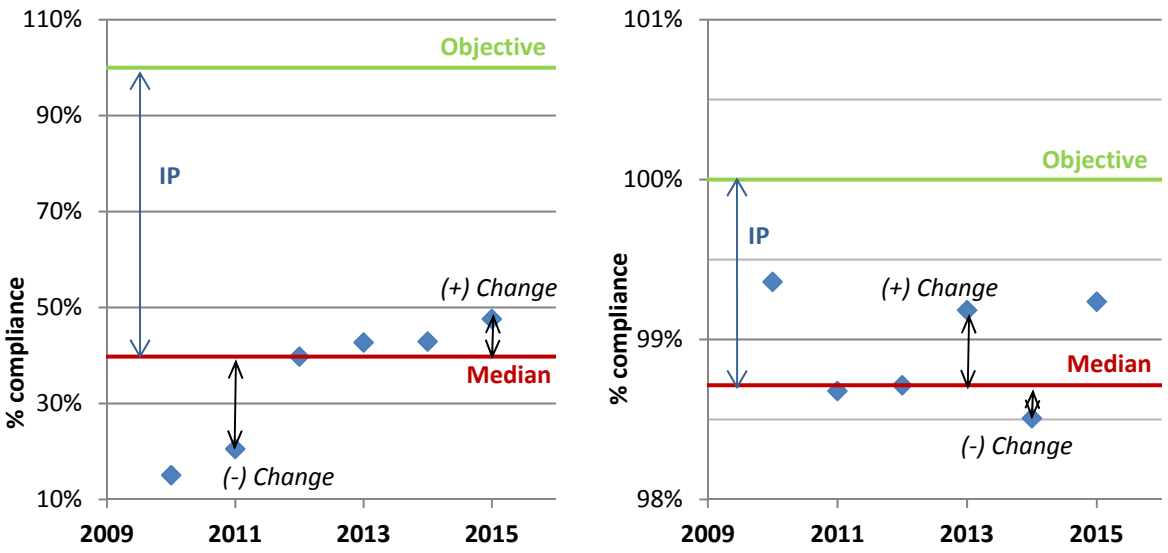
with

n = number of indicators

$$Result\ indicator_i = \left[\frac{result\ year_x - median_i}{IP_i}\right] x\ 100\% \quad \text{(eq. 6.2.2.)}$$

$$IP_i = [objective_i] - [median_i] \quad \text{(eq. 6.2.3.)}$$

Expression of the indicator results compared to an objective and in terms of an IP is illustrated for two examples of indicators in Figure 1.



a) Example of an indicator with a large improvement potential (IP)

b) Example of an indicator with a limited improvement potential (IP)

Figure 1. Illustration of the expression of the indicator result compared to its objective and in terms of its improvement potential (IP)

The more the indicator result approaches 100%, the better the objective is reached. A negative sign indicates that the reported result of $year_x$ is below the median result of a given timeframe. The more negative this result, the larger the margin between the reported result of a given $year_x$ and the targeted objective (i.e. comparable to a thermometer with the boiling point as a final destination). An increase thus reflects a positive trend of the indicator towards its objective, i.e. an improvement. This is also schematically represented in Table 2.

Table 2. Interpretation of indicator results measured in function of objectives

Result $indicator_i$	Interpretation	PHIs in general + IP	PHIs for which an increase corresponds to a deterioation of the state - IP
> 0 % (+ sign)	Positive trend towards objective	Result $year_x$ > $median_i$	Result $year_x$ < $median_i$
= 0 %	↑	Result $year_x$ = $median_i$	Result $year_x$ = $median_i$
< 0 % (- sign)	Negative trend towards objective	Result $year_x$ < $median_i$	Result $year_x$ > $median_i$

6.2.4. Representation of the state

The two categories of indicators, namely the indicators related (i) to the preventive approach and (ii) to plants/plant products control, are influenced by different kinds of pressure on the plant production chain and reflect different aspects of the plant health state. For instance, indicators related to the

preventive approach refer to pro-active actions taken to prevent hazardous plants/plant products from entering the market whereas indicators related to control of plants/plant products measure the plant health state more directly. Therefore, preference is given to a representation of the state compared to predefined objectives for each indicator category separately. A color scale can be used as a practical communication tool to indicate which indicators are potentially a point of concern (alert signal, cf. traffic light).

Similarly to version 2.1, the barometer version 2.2 allows risk managers anticipating potential changes or pressures on plant health and to observe long term trends, both as regarding the individual indicators, the indicator categories and the barometer itself (across all indicators).

7. Discussion of results

7.1. New plant health indicators

Considering the change of each new PHI between 2010 and 2015 (see Table 3), the three most fluctuating indicators are PHI03 (annual number of 'first report/first detection' of plant harmful organisms in Belgium), PHI10 (regulated phytophagous or xylophagous insects controls) and PHI01 (mandatory notification of plant diseases and plant harmful organisms) with respective intervals of [1; 7] (= maximal difference of 600% compared to the minimum), [26.1%; 93.1%] (= maximal difference of 257% compared to the minimum) and [13; 28] (= maximal difference of 115% compared to the minimum). Conversely, PHI04 (phytosanitary inspections (traceability)), PHI11 (regulated phytophagous or xylophagous nematodes controls) and PHI08 (regulated phytopathogenic bacteria controls) are the three most stable ones with respective intervals of [97.5%; 98.9%] (= maximal difference of 1% compared to the minimum), [97.8%; 99.3%] (= maximal difference of 2% compared to the minimum) and [93.8%; 96.6%] (= maximal difference of 3% compared to the minimum). PHI02 (self-checking for plant production), PHI07 (regulated phytopathogenic viruses and viroids controls) and PHI09 (regulated phytopathogenic fungi controls) seem to show a positive trend during this period of time (2010-2015).

Regarding the indicators related to the control of traceability and to the control of plants/plant products, it has to be taken into account that from time to time changes are made regarding the evaluation system (e.g. the use of new inspection checklists, a change of legal limits/action limits). These changes can affect the year-to-year differences with regard to the detection of non-compliant results. When important changes to the evaluation system are made, both the sector and the authorities make strong efforts to sensitize, inform and assist the concerned operators. Additionally, it has to be taken into account that some inspections or controls may have been aimed at high-risk production sites, products or countries of origin as a result of which some degree of bias may be involved. On the other hand, in defining the indicators related to the control of plants/plant products, it is opted, to the extent possible, to only include the results of the control program, with the exclusion of results of analysis from samples that were taken following complaints or incidents.

7.2. Plant Health Barometer 2.1

Based on the new basket of plant health indicators (see 5 and Table 1) and compared to the previous year (see 6.1), the plant health barometer version 2.1 shows three negative results for 2011, 2013 and 2014 (-9.2%, -3.6% and -17.7% respectively) and two positive results for 2012 and 2015 (+6.5% and +14.6% respectively, see Table 3). Since 2010, the Belgian plant health state has therefore also evolved the same way.

Considering the change of each indicator in 2015 compared to 2014, it is observed that the plant health barometer version 2.1 is mainly determined by PHI03 (annual number of 'first report/first detection' of plant harmful organisms in Belgium), PHI01 (mandatory notification of plant diseases and plant harmful organisms) and PHI10 (regulated phytophagous or xylophagous insects controls) with respective change percentages of +75.0%, +42.9% and +37.6%. The seven other PHIs seem to be rather stable (change percentage ≤ 3.0%). Based on the plant health barometer version 2.1, it could be concluded that the Belgian plant health state has improved by +14.6% in 2015 compared to 2014.

Notice that the global results for barometer version 2.1 cannot be compared as such with the global results reported for barometer version 1.0. Not only the basket of indicators changed, but also no weighting of the indicators has been included in the barometer version 2.1 as it is now presented. As a consequence, each indicator has a similar impact on the final barometer 2.1 result.

Table 3. Overview of the plant health barometer version 2.1 from 2011 until 2015

PHI	Short description [a]	Results						% change [b]				
		2010	2011	2012	2013	2014	2015	2011	2012	2013	2014	2015
Preventive approach												
01	Mandatory notification of plant diseases and harmful organisms [c]	25	15	13	14	28	16	+40.0%	+13.3%	-7.7%	-100.0%	+42.9%
02	Self-checking for plant production	35.5%	44.9%	43.3%	53.4%	56.5%	55.9%	+26.3%	-3.4%	+23.3%	+5.7%	-0.9%
03	Annual number of 'first report/first detection' of plant harmful organisms in Belgium [c]	2	7	2	3	4	1	-250.0%	+71.4%	-50.0%	-33.3%	+75.0%
04	Phytosanitary inspections (traceability)	98.0%	98.1%	97.5%	98.0%	98.4%	98.9%	+0.1%	-0.6%	+0.5%	+0.4%	+0.5%
Control of plants/plant products												
05	Plant harmful organisms regulated and detected in Belgium [c]	6.6%	7.1%	8.6%	6.5%	7.0%	7.0%	-6.6%	-21.8%	+24.7%	-7.7%	-0.4%
06	Phytosanitary import controls	88.7%	92.3%	84.8%	74.9%	78.1%	80.2%	+4.1%	-8.1%	-11.6%	+4.3%	+2.6%
07	Regulated phytopathogenic viruses and viroids controls	88.4%	93.4%	96.3%	99.0%	98.9%	99.2%	+5.6%	+3.1%	+2.8%	-0.1%	+0.3%
08	Regulated phytopathogenic bacteria controls	96.3%	96.1%	94.5%	95.7%	93.8%	96.6%	-0.2%	-1.6%	+1.2%	-2.0%	+3.0%
09	Regulated phytopathogenic fungi controls	93.4%	97.8%	97.7%	97.4%	98.2%	98.2%	+4.7%	-0.1%	-0.3%	+0.9%	-0.1%
10	Regulated phytophagous or xylophagous insects controls	44.4%	77.4%	93.1%	72.6%	26.1%	35.9%	+74.2%	+20.2%	-22.0%	-64.1%	+37.6%
11	Regulated phytophagous or xylophagous nematodes controls	98.5%	99.1%	98.4%	97.8%	99.1%	99.3%	+0.6%	-0.7%	-0.6%	+1.3%	+0.2%
GLOBAL								**-9.2%**	**+6.5%**	**-3.6%**	**-17.7%**	**+14.6%**

Legend:

[a] More information is given in the PHI technical sheets (Appendix 3: Detailed technical sheets of the plant health indicators.); [b] change in terms of percentage = [(PHI result year 2 - PHI result year 1) / PHI result year 1] x 100%; [c] given that a decrease of the indicator result indicates an improvement of the plant health state, the sign of its relative % change is changed.

7.3. Plant Health Barometer 2.2

Based on the new basket of plant health indicators (see 5 and Table 1) and compared to their respective predefined objective (see 6.2), Table 4 illustrates the plant health barometer version 2.2 approach for 2014 and 2015. For the purpose of comparing 2 years, the median was calculated based on a fixed period of 4 years (2010-2013).

The discussion of the barometer version 2.2 results can be based on quantitative measures by comparing the PHI results with their IP in terms of percentage (preferentially per PHI category) or on qualitative observations by means of a color scale. The colors in Table 4 are based on a conditional 3-color scale, going from dark red for the minimum PHI result observed in 2014-2015, over yellow for an PHI result of 0%, to dark green for an PHI result of 100% (meaning that the objective for the PHI is reached).

Considering the change of each indicator in 2015 compared to the IP, it can be observed that the plant health barometer version 2.2 is mainly determined by PHI10 (regulated phytophagous or xylophagous insects controls), PHI07 (regulated phytopathogenic viruses and viroids controls) and PHI03 (annual number of 'first report/first detection' of plant harmful organisms in Belgium) with respective change percentages of -156,7%, +84,3% and +60,0%. Based on the plant health barometer version 2.2, it could be concluded that the Belgian plant health state has improved by +7,7% in 2015 compared to the median of the period 2010-2013 and to the predefined ambitious objective of each PHI.

Considering the change of each PHI category in 2014 and in 2015 compared to the IP, a positive trend can be observed for the two categories: the preventive approach varies from -27,8% to +28,5% and the control of plant/plant products from -24,0% to -4,2%.

The timeframe to be considered for calculating the median value, which serves as a reference point, can be based on management criteria (see 6.2). It is a determining factor in this approach as it has an influence on the relative changes observed within the PHI categories. The shorter this timeframe the smaller the basis for comparing one year to another and the less stability in the positive/negative tendencies observed. This is the more so when a moving X-year window is applied. If the plant health state shows a positive trend, the pressure for reaching the predefined objectives, or in other words to 'perform', becomes higher. As a consequence, the 'reference' median value will increase if a continuous moving window is applied. As such, not only the IP becomes smaller (i.e. the denominator, see eq. 6.2.2), but also the difference between the result of the PHI and its 'reference' median (i.e. the numerator, see eq. 6.2.2) is affected. So when the PHI result does not follow a similar trend as the 'reference' median when a moving X-year window is applied, there is a relative deceleration in the positive trend towards the objectives.

It should be kept in mind that the barometer 2.2. results presented in Table 4 only cover a small time frame, possibly too small for drawing firm conclusions. Nevertheless, they illustrate the signal function of barometer version 2.2, enabling to identify the plant health areas that might receive additional attention. Barometer version 2.2 should be viewed complimentary to barometer version 2.1. It is optional to show the quantitative results and/or the color scale.

Table 4. Overview of the plant health barometer version 2.2 for 2014 and 2015 (based on a fixed 4-years window)

PHI	Short description [a]	OBJ	Median [b] 2010-2013	IP [c] 2010-2013	Relative change towards objectives [d] Per PHI 2014	Per PHI 2015	Color scale representation [e] 2014	Color scale representation [e] 2015	Mean per PHI category 2014	Mean per PHI category 2015
Preventive approach										
01	Mandatory notification of plant diseases and harmful organisms	0	14.5	-14.5	-93.1%	-10.3%				
02	Self-checking for plant production	100%	44.1%	55.9%	+22.1%	+21.2%				
03	Annual number of 'first report/first detection' of plant harmful organisms in Belgium	0	2.5	-2.5	-60.0%	+60.0%			**-27.8%**	**+28.5%**
04	Phytosanitary inspections (traceability)	100%	98.0%	2.0%	+20.0%	+43.0%				
Control of plants/plant products										
05	Plant harmful organisms regulated and detected in Belgium	0%	6.9%	-6.9%	-1.9%	-2.3%				
06	Phytosanitary import controls	100%	86.7%	13.3%	-64.7%	-49.4%				
07	Regulated phytopathogenic viruses and viroids controls	100%	94.8%	5.2%	+78.6%	+84.3%				
08	Regulated phytopathogenic bacteria controls	100%	95.9%	4.1%	-50.9%	+17.4%			**-24.0%**	**-4.2%**
09	Regulated phytopathogenic fungi controls	100%	97.6%	2.4%	+27.9%	+25.4%				
10	Regulated phytophagous or xylophagous insects controls	100%	75.0%	25.0%	-195.9%	-156.7%				
11	Regulated phytophagous or xylophagous nematodes controls	100%	98.4%	1.6%	+39.1%	+51.8%				
GLOBAL					**-25.4%**	**+7.7%**				

Legend:

[a] More information is given in the PHI technical sheets (Appendix 3: Detailed technical sheets of the plant health indicators.); [b] median value of individual PHI results (see Table 3) over a fixed 4-years period of 2010 to 2013; [c] improvement potential (IP) = objective – median; [d] relative change compared to the objective calculated as: [(PHI result-median) / IP] x 100%; [e] 3-color scale comparing the relative change towards the objectives for the 11 PHIs over 2 years (going from a red color for the most negative trend towards a green color for the most positive trend).

8. Answer to the questions

(i) Are the current indicators still relevant?

As mentioned in SciCom Opinion 10-2011 (SciCom, 2011b), the composition of the basket of indicators may be adapted periodically. Given that the barometer version 1.0 already covers a large period (composed in 2010 with data going back to 2007), the original indicator basket was evaluated according to a number of criteria (see 5). This resulted in a new basket containing 11 PHIs, which were evaluated in terms of their relevance, acceptability, credibility, easiness to monitor and robustness (i.e. RACER criteria in Appendix 4: RACER criteria applied to the plant health indicators. & technical sheets in Appendix 3: Detailed technical sheets of the plant health indicators.). An overview of the indicators deleted, kept, changed, or newly defined together with a short justification is given in Appendix 2: Overview of plant health indicators deleted, kept, changed or newly defined..

(ii) How to deal with indicators whose interpretation is open to debate?

The indicator related to the number of mandatory notifications received yearly by the FASFC with regards to the detection of plant diseases and plant harmful organisms (PHI01) has been kept but its interpretation was reversed compared to plant health barometer version 1.0 (see 5). More notifications is now interpreted as a deterioration of the state and not more as an indication of increased awareness of the sector.

(iii) Should new indicators be included?

A number of new indicators are proposed to be included into the barometers versions 2.1 and 2.2 (see 5), some of them replacing previous indicators.

(iv) Is a new weighting of the indicators required?

A new weighting of the PHIs, in function of their direct relationship to plant health as perceived by various stakeholders in the plant production chain, is not a prerequisite, but is recommended. Moreover, inclusion of such an assessment of the relative importance of the PHIs on plant health was identified as one of the strengths in the SWOT analysis (see Appendix 1: Summary of the results of the SWOT analysis of the barometers.).

(v) Should the current scale definition (barometer version 1.0) be maintained?

The difficulty remains that plant health cannot be expressed in absolute values (see SWOT analysis, Appendix 1: Summary of the results of the SWOT analysis of the barometers.). Given the straightforward approach of barometer version 1.0, it was decided to maintain the current scale definition. Besides the scale definition of barometer version 1.0 applied to the new set of PHIs (i.e. barometer version 2.1), an alternative scale definition based on a measurement compared to predefined objectives (i.e. barometer version 2.2) is nonetheless proposed. The two scales can be used in a complementary way (see 6).

(vi) Is a trend analysis based on the barometer results possible?

The 'analysis', or rather the 'observation' of trends is possible and comes down to what can be visually observed from the barometer results over time. Whereas the final barometer result is used as a first line of communication, the actual evaluation of the plant health state is based on the individual indicator results. The primary goal of the barometer is to measure the overall plant health state and change, on the basis of indicators that are related to monitoring and ensuring of plant health throughout the entire plant production chain, and not to conduct a comprehensive plant health assessment (SciCom, 2011b).

9. Conclusions

The plant health barometer version 1.0 (= current version) has been revised. The original basket of 13 plant health indicators has been reduced to 11 indicators.

Based on this new basket, two approaches are proposed and illustrated for presenting the plant health state, namely (i) as a measurement in terms of a relative change of state between two consecutive years (i.e. version 2.1, with a similar approach to that used in version 1.0), and (ii) as a measurement compared to predefined objectives (i.e. version 2.2, with a new approach as used in version 1.0). In this sense, both approaches complement each other since the first approach or barometer version 2.1 is rather a communication tool, whereas the second approach or barometer version 2.2 is a more policy-orientation instrument.

The current Opinion concerns the scientific evaluation of the concept of the plant health barometer. Although the Scientific Committee proposed a methodology of approach, it is up to the FASFC to turn the concept into reality, amongst others with respect to the predefined objectives, the chosen window of comparison, etc. Additional refinement of the barometer versions might consist of a weighting of the indicators according to their direct relationship to plant health as perceived by various stakeholders in the plant production chain.

For the Scientific Committee,
Chairman,

Prof. Dr. E. Thiry (Sgd.)
Brussels, 26/04/2018

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Presentation of the Scientific Committee of the FASFC

The Scientific Committee is an advisory body of the Belgian Federal Agency for the Safety of the Food Chain (FASFC) that provides **independent scientific opinions** on risk assessment and risk management in the food chain, and this at the request of the Chief Executive Officer of the FASFC, the Minister competent for food safety or at its own initiative. The Scientific Committee is administratively and scientifically supported by the Staff direction for Risk Assessment of the Agency.

The Scientific Committee consists of 22 members who are appointed by royal decree on the basis of their scientific expertise in areas related to the safety of the food chain. When preparing an opinion, the Scientific Committee can call on external experts who are not a member of the Scientific Committee. Similar to the members of the Scientific Committee, they must be able to work independently and impartially. To ensure the independence of the opinions, potential conflicts of interest are managed transparently.

The opinions are based on a scientific assessment of the question. They express the view of the Scientific Committee which is taken in consensus on the basis of a risk assessment and the existing knowledge on the subject.

The opinions of the Scientific Committee may contain **recommendations** for food chain control policy or for the stakeholders. The follow-up of these recommendations for control policy is the responsibility of the risk managers.

Questions on an opinion can be directed to the secretariat of the Scientific Committee: Secretariat.SciCom@afsca.be.

Members of the Scientific Committee

The Scientific Committee 2013-2017, which has given the provisional Opinion, was composed of the following members:

D. Berkvens, A. Clinquart, G. Daube, P. Delahaut, B. De Meulenaer, S. De Saeger, L. De Zutter, J. Dewulf, P. Gustin, L. Herman, P. Hoet, H. Imberechts, A. Legrève, C. Matthys, C. Saegerman, M.-L. Scippo, M. Sindic, N. Speybroeck, W. Steurbaut, E. Thiry, M. Uyttendaele, T. van den Berg

The Scientific Committee 2017-2021, which has given the final Opinion, is composed of the following members:

S. Bertrand*, M. Buntinx, A. Clinquart, P. Delahaut, B. De Meulenaer, N. De Regge, S. De Saeger, J. Dewulf, L. De Zutter, M. Eeckhout, A. Geeraerd, L. Herman, P. Hoet, J. Mahillon, C. Saegerman, M.-L. Scippo, P. Spanoghe, N. Speybroeck, E. Thiry, T. van den Berg, F. Verheggen, P. Wattiau
* until 23/3/2018

Conflict of interest

No conflicts of interest were notified.

Acknowledgements

The Scientific Committee acknowledges the Staff direction for Risk Assessment and the members of the workgroup for preparing the draft opinion.

Composition of the workgroup

The workgroup was composed of:

Members of the Scientific Committee:	A. Legrève (reporter), D. Berkvens, N. Speybroeck, W. Steurbaut, M. Uyttendaele
External experts:	C. Bragard (UCL), M. Höfte (UGent)
File manager:	O. Wilmart

The activities of the workgroup were attended by the following members of the administration (as observers): D. Michelante (FASFC) and V. Huyshauwer (FASFC).

Open consultation

In order to increase transparency, but without compromising the independent position of the Scientific Committee, members of the FASFC Advisory Committee and various stakeholders in the plant production chain were invited to communicate their comments. The open consultation took place from 19 June 2017 until 15 September 2017. No comments were received regarding the content.

Legal framework

Law of 4 February 2000, on the creation of the Federal Agency for the Safety of the Food Chain, in particular article 8;
The Royal Decree of 19 May 2000, on the composition and operating procedures of the Scientific Committee, as established within the Federal Agency for the Safety of the Food Chain;
The Internal Rules as mentioned in Article 3 of the Royal Decree of 19 May 2000, on the composition and operating procedures of the Scientific Committee, as established within the Federal Agency for the Safety of the Food Chain, approved by the Minister on 8 June 2017.

Disclaimer

The Scientific Committee at all times reserves the right to modify the opinion by mutual consent, should new information and data become available after the publication of this version.

Appendix 1: Summary of the results of the SWOT analysis of the barometers.

trengths:

1. allows trend observation

2. displays the global state of the change in food safety, in plant health and in animal health

3. the scientific validation

The barometer was developed by the Scientific Committee and published in peer reviewed journals

4. the calculation of the barometers (the various indicators) stimulates the evaluation and improvement of the data quality

5. the relative importance of the indicators for food chain safety was assessed by different stakeholders, which increases the acceptance of the barometers

eaknesses:

1. the possible, contradictory interpretation of indicators related to notifications

In the original sense, these indicators (e.g. mandatory notifications food safety, notifiable animal diseases/plant diseases and pests, reports of bovine abortions) are to be interpreted as a measure of the vigilance of the sector. This may seem contradictory at large deflections in positive or negative sense.

2. the interpretation of the final barometer result

Is the observed improvement/decrease realistic? How should the percentual increase/decrease or the barometer scale be interpreted? The barometer is not an absolute measure of the state.

3. the explanation of the final barometer result can often be reduced to fluctuations observed for a limited number of indicators

4. the barometer is insufficiently known by operators and consumers

This has more to do with communication than with the barometer itself. However, explanation of the barometer result requires sometimes a too technical explanation.

5. the barometer does not include indicators related to emerging risks / hazards or niche products

pportunities:

1. increases the (inter)national visibility of the FASFC

2. become a promotional tool for the Belgian food chain approach & products

3. In the context of an ever more harmonized market, the development of a European barometer is a possible opportunity (see also the EU baseline studies) for which the barometer is a possible starting point

4. linking to the cycle of the "Multi Annual National Control Plan' (MANCP)

(i) linking of objectives laid down in advance by policy with indicators to be followed during a MANCPs cycle, and (ii) periodic assessment of the relevance of the indicators at the end of a MANCP cycle

reaths:

1. wrong interpretation of the barometer result / objective / concept

e.g. interpretation of the barometer as a measurement of the functioning of the FASFC or of the health state of the Belgian population. This threat underlines the importance of good communication that includes consideration of the change of the food chain safety state over several years.

2. the barometer loses its pertinence

e.g. because the barometer shows no change anymore, the trend observed is contradictory to the perception in the field, etc.

Appendix 2: Overview of plant health indicators deleted, kept, changed or newly defined.

The indicators that are deleted from the new basket are indicated in red and those that are kept in green. New or alternative indicators that were considered, are given in blue if kept and in grey if they were not kept.

Indicators related to the preventive approach	
Mandatory notification of plant diseases and plant harmful organisms *(kept)*	The indicator is kept but its interpretation is reversed, compared to the interpretation of this same indicator in the plant health barometer version 1.0. In the plant health barometers versions 2.1 and 2.2, more notifications mean a deterioration of the plant health state. In the plant health barometer version 1.0, more notifications was interpreted as a higher degree of vigilance of the operators with regard to the safeguarding of plant health. The indicator is kept even if it could be influenced by external factors like media campaigns aiming at notification stimulating, scientific research activities or the degree of vigilance of the operators.
Self-checking for plant production *(kept)*	The indicator is kept but its scope is broadened to all activities within the plant production chain, not only "key activities" (= activity representing a considerable production volume and/or having a considerable impact on the plant health because of the very nature of the activity) as previously in the plant health barometer version 1.0.
Annual number of 'first report/first detection' of plant harmful organisms in Belgium *(new)*	The indicator is added to the basket of indicators. The indicator is a measurement of the risk that Belgium faces with regards to the emergence of harmful organisms. If the report/detection concerns a regulated plant harmful organism, the information will also be included in the PHI05.
Fungicide resistance *(considered, but not kept)*	These potential indicators are not kept because either the data needed to their calculation are little or not available, or they are (highly) influenced by the weather conditions.
Pesticides usage statistics *(considered, but not kept)*	
Invasive alien plants *(considered, but not kept)*	
Number of samples send by private persons to plant disease clinics for diagnosis *(considered, but not kept)*	
Agricultural early warning systems *(considered, but not kept)*	
Crop yields *(considered, but not kept)*	
Endemic diseases pressure *(considered, but not kept)*	
Weather conditions *(considered, but not kept)*	This potential indicator is not kept because it represents a pressure influencing the plant health state and the aim of the plant health barometer is to measure only the plant health state.
Phytosanitary inspections (physical checks) *(deleted)*	The indicator is removed from the basket of indicators because, since 2013, a change in the way of weighting the checklist used for these inspections has resulted in 100 % compliance each year.

Phytosanitary inspections (traceability) *(kept)*	The indicator is kept.
Indicators related to the control of plants/plant products	
Plant harmful organisms regulated and detected in Belgium *(kept)*	The indicator is kept. When a regulated plant pest or pathogen is detected in Belgium, the latter is added to this indicator and when it is eradicated from Belgium, then the latter is removed from this indicator.
Phytosanitary import controls *(kept)*	The indicator is kept.
Bursaphelenchus xylophilus (Pine wood nematode) *(deleted)*	These indicators are replaced by 5 more generic indicators on regulated plant pests (nematodes and insects) and pathogens (fungi, viruses/viroids and bacteria) to give a fuller picture of the plant health state (see below). In addition, these indicators present a high compliance level and are less weighted.
Meloidogyne chitwoodi and/or *M. fallax* (Root-knot nematodes) *(deleted)*	
Globodera rostochiensis and/or *G. pallida* (Cyst nematodes) *(deleted)*	
Ralstonia solanacearum and/or *Clavibacter michiganensis* subsp. *sepedonicus* (Potato brown rot and/or ring rot) *(deleted)*	
Pospiviroidae *(deleted)*	
Diabrotica virgifera Le Conte (Corn rootworm) *(deleted)*	
Phytophthora ramorum (Ramorum disease) *(deleted)*	
Regulated phytopathogenic viruses and viroids controls *(new)*	These indicators are replacing the 7 previous specific ones to give a fuller picture of the plant health state (see above). Import controls are excluded from these indicators to avoid redundancy with PHI06.
Regulated phytopathogenic bacteria controls *(new)*	
Regulated phytopathogenic fungi controls *(new)*	
Regulated phytophagous or xylophagous insects controls *(new)*	
Regulated phytophagous or xylophagous nematodes controls *(new)*	

Appendix 3: Detailed technical sheets of the plant health indicators.

PHI01: Mandatory notification of plant diseases and plant harmful organisms

Description: The number of notifications received by the FASFC each year with regards to the detection of plant diseases and plant harmful organisms (excluding official control plan).

Category: Preventive measures.

✅	**R**elevance of the indicator: The presence/introduction on the Belgian territory of harmful quarantine organisms can be extremely detrimental, economically speaking, to plants and plant products production. Crisis prevention and management via mandatory notification is essential for maintaining or improving the plant health state.
✅	**A**ccepted: According to Royal Decree of 14/11/2003 (concerning self-checking, compulsory notification and traceability in the food chain), each and every operator carrying out activities that fall under the competence of the FASFC is required to inform the FASFC of any suspicion or reason to assume that a product that was imported, produced, grown, processed, manufactured or distributed by it constitutes a potential health hazard for plants (= product infested/infected with a regulated pest/disease). The same requirement applies to each and every laboratory, research center or inspection/certification body.
✅	**C**redible: An increase of the number of notifications can indicate a deterioration of the plant health state.
✅	**E**asy to monitor: Data are collected by the FASFC.
✅	**R**obust: Could be influenced by media campaigns aiming at notification stimulating, by scientific research activities and by the degree of vigilance of the operators.

Results:

Year	Indicator = number of notifications	% compliance	Change compared to preceding year (in %)*	Limit
2015	16	Not applicable	+42.9%	Not applicable
2014	28		-100.0%	
2013	14		-7.7%	
2012	13		+13.3%	
2011	15		+40.0%	
2010	25		-	

*The sign of the comparison of two consecutive years was reversed, because an increase of the number of notifications is interpreted as a deterioration of the plant health state and vice versa.

Trend: No steady trend is observed between 2010 and 2015. Highly fluctuating indicator.

Goal: No notification.

Additional information: More information regarding the mandatory notification can be found at: http://www.favv-afsca.fgov.be/notificationobligatoire/.

PHI02: Self-checking for plant production

Description: The percentage of activities performed with a validated/certified self-checking system (SCS) in the plant production sector.

Category: Preventive measures.

✅	**R**elevance of the indicator: This indicator serves as a criterion for the percentage of activities for which a validated/certified SCS (self-checking system) is available. A validated/certified SCS is an SCS that has been declared to be compliant with the set of requirements after investigation by a third party (FASFC or a certification body). An independently validated/certified SCS enhances its added value and makes it more trustworthy with regard to its foundations and functioning. An increase of the percentage of activities with a validated/certified self-checking system thus indirectly leads to a higher confidence level with regard to adequate preventive actions taken in order to ensure overall plant health.
✅	**A**ccepted: Operators may freely decide whether or not to have their SCS validated. Absence of a validation does not mean that the SCS is absent or that it does not function properly. However, validation by a third party is a surplus and is more credible as it is done independently.
✅	**C**redible: On the basis of a sector guide and performed by means of a check-list, companies can have their SCS validated by a certification or inspection body (OCI) that has been recognized as such by the FASFC. In case there is no approved guide available for a certain sector, or if no OCI has been recognized by the FASFC, the operator may resort to the FASFC for conducting the validation.
✅	**E**asy to monitor: Data are collected by the FASFC.
✅	**R**obust.

Results:

Year	Number of activities performed	Indicator = % of activities performed with a validated/certified self-checking system	Change compared to preceding year (in %)	Limit
2015	43,417	55.9%	-0.9%	Not applicable
2014	46,887	56.5%	+5.7%	
2013	45,646	53.4%	+23.3%	
2012	47,323	43.3%	-3.4%	
2011	47,507	44.9%	+26.3%	
2010	47,758	35.5%	-	

Trend: A positive general trend is observed between 2010 and 2015.

Goal: 100% of the activities performed with a validated/certified self-checking system.

Additional information:

- In early 2013, a new activity tree was put in place by the FASFC, in which certain activities were merged or split, new activities were created and some activities were removed.
- Selection of activities on activity 'AC64 = production' and on place 'PL42, PL60, PL69, PL91' and on product 'PR69, PR88, PR112, PR113, PR131, PR206-211, PR217' from the LAP/PAP list version 5.0.
- More information regarding self-checking can be found at: http://www.favv-afsca.fgov.be/autocontrole-fr/.

PHI03: Annual number of 'first report/first detection' of plant harmful organisms in Belgium

Description: The annual number of 'first report/first detection' of plant harmful organisms in Belgium according to the EPPO Reporting Service articles (https://gd.eppo.int/country/BE/reporting), to *Plant Disease* and to *European Journal of Plant Pathology*.

Category: Preventive measures.

✅	**R**elevance of the indicator: The presence on the Belgian territory of harmful regulated or emerging organisms can be extremely detrimental, economically speaking, to plants and plant products production. It is therefore essential that researchers, authorities and individuals stay sufficiently alert to be able to detect as early as possible any new pests.
✅	**A**ccepted: This indicator is a measurement of the risk that Belgium faces with regards to the emergence of harmful organisms.
✅	**C**redible: An increase of this indicator can be associated with a deterioration of the plant health state in Belgium.
✅	**E**asy to monitor: Data are publicly available.
✅	**R**obust: could be influenced by the scientific research activities.

Results:

Year	Indicator = number of 'first report/first detection'	% compliance	Change compared to preceding year (in %)*	Limit
2015	1	Not applicable	+75.0%	Not applicable
2014	4		-33.3%	
2013	3		-50.0%	
2012	2		+71.4%	
2011	7		-250.0%	
2010	2		-	

*The sign of the comparison of two consecutive years was reversed, because an increase of the number of 'first report/first detection' of plant harmful organisms in Belgium actually is interpreted as a deterioration of the plant health state and vice versa.

Trend: No steady trend is observed between 2010 and 2015. Highly fluctuating indicator.

Goal: No first report/first detection.

Additional information:

- Species concerned:
  - 2015: *Cryphonectria parasitica*
  - 2014: *Aproceros leucopoda*, *Clavibacter michiganensis* subsp. *sepedonicus* (first report of a natural infection on tomato), *Callidiellum rufipenne*, *Fusarium langsethiae*
  - 2013: *Chrysanthemum stem necrosis virus, Meloidogyne artiellia*, *Fusarium miscanthi*
  - 2012: *Candidatus* Phytoplasma pyri, *Aculops fuchsiae*
  - 2011: *Drosophila suzukii*, *Hymenoscyphus pseudoalbidus*, *Candidatus* Phytoplasma mali, *Calonectria colhounii*, *Pilidium concavum*, *Tomato apical stunt viroid*, *Hymenoscyphus pseudoalbidus*
  - 2010: *Rhagoletis cingulata*, *Nysius huttoni*
- Information is already included in PHI05 if it concerns a regulated pest.

PHI04: Phytosanitary inspections (traceability)

Description: The percentage of annual phytosanitary inspections relating to traceability in the plant production sector that were deemed to be 'favorable' or 'favorable, subject to remarks'.

Category: Preventive measures.

✅	**R**elevance of the indicator: Traceability means the possibility to trace and follow any product throughout all phases of the production, processing and distribution processes. As such, traceability is an important aspect of safeguarding plant health and is crucial for an efficient crisis management. Inspections with regard to traceability are an important to evaluate if operators have an efficient traceability system in place. An increase of this indicator indicates a better control of plant health.
✅	**A**ccepted: This indicator indicates if operators meet the legal requirements with regard to traceability. The checklists on which the inspections are based, are available on the website of the Agency[1] enabling operators to evaluate if their business is in compliance with regulations.
✅	**C**redible: The result of an inspection is determined on basis of a checklist, by which a fixed appraisal, under the form of a points score, will made for each item to be controlled, and in function of its relative importance. As for the results of any inspection, there are 3 possibilities: either 'favorable', 'favorable with remarks' or 'unfavorable'. The latter will result in further measures to be taken or in the drawing up of an official report.
✅	**E**asy to monitor: Inspections are performed by the FASFC. Data are then centralized within the FASFC.
✅	**R**obust.

Results:

Year	Number of phytosanitary inspections relating to traceability	Indicator = % 'favorable' or 'favorable with remarks'	Change compared to preceding year (in %)	Limit
2015	1,056	98.9%	+0.5%	Not applicable
2014	1,204	98.4%	+0.4%	
2013	1,159	98.0%	+0.5%	
2012	1,020	97.5%	-0.6%	
2011	1,035	98.1%	+0.1%	
2010	1,101	98.0%	-	

Trend: Overall, a positive trend is observed between 2010 and 2015. The results show a high compliance.

Goal: 100% of the inspections 'favorable' or 'favorable with remarks'.

Additional information: More information regarding traceability can be found at: http://www.favv-afsca.fgov.be/autocontrole-fr/tracabilite/.

[1] http://www.favv-afsca.be/checklists-fr/

PHI05: Plant harmful organisms regulated and detected in Belgium

Description: The percentage of regulated plant harmful organisms for which at least one sample is tested positive per year in Belgium in relation to the total number of regulated plant harmful organisms.

Category: Control of plants/plant products.

✅	**R**elevance of the indicator: The presence on the Belgian territory of regulated harmful organisms can be extremely detrimental, economically speaking, to plants and plant products production and to international trade. It is therefore essential to follow this parameter carefully and to eventually take the necessary control measures, with the objective of maintaining/improving the phytosanitary state.
✅	**A**ccepted: This indicator measures the extent to which plants and plant products are subject to the pressure of harmful quarantine organisms.
✅	**C**redible: An increase of this indicator is associated with a deterioration of the plant health state in Belgium.
✅	**E**asy to monitor: Data are collected by the FASFC.
✅	**R**obust.

Results:

Year	Number of different plant harmful organisms detected	Indicator = % in relation to the total number of regulated plant harmful organisms	Change compared to preceding year (in %)*	Limit
2015	16	7.0%	-0.4%	Not applicable
2014	16	7.0%	-7.7%	
2013	15	6.5%	+24.7%	
2012	20	8.6%	-21.8%	
2011	16	7.1%	-6.6%	
2010	15	6.6%	-	

* The sign of the comparison of two consecutive years was reversed, because an increase of the percentage of regulated plant harmful organisms for which at least one sample is tested positive per year in Belgium in relation to the total number of regulated plant harmful organisms is interpreted as a deterioration of the plant health state and vice versa.

Trend: No steady trend can be observed between 2010 and 2015.

Goal: No detection of regulated plant harmful organism.

Additional information:

- Regulated harmful organisms detected during phytosanitary import controls are not included in this indicator.
- Harmful organisms that are exclusively regulated for protected EU zones are not covered by this indicator either (i.e. solely those covered in part B of the Royal Decree of 10/08/2005, and not those listed in the other parts or sections).
- The harmful organisms listed in the Royal Decree of 19/11/1987 for which no active control policy has been conducted are not covered either.
- When a regulated plant pest or pathogen is detected in Belgium, the latter is added to this indicator and when it is eradicated from Belgium, then the latter is removed from this indicator.

PHI06: Phytosanitary import controls

Description: The percentage of samples of plants and plant products consignments, imported into the EU via the Belgian border inspection posts (BIP), which are compliant with the plant health requirements.

Category: Control of plants/plant products.

✅	**R**elevance of the indicator: The presence on the Belgian territory of harmful regulated organisms can be extremely detrimental, economically speaking, to plants and plant products production. It is therefore essential to maintain/improve the phytosanitary state by verifying the absence of these organisms in the imported plants and plant products.
✅	**A**ccepted: This indicator is a measurement of the risk that Belgium faces with regards to the introduction of harmful regulated organisms.
✅	**C**redible: This indicator demonstrates that the active plants and plant products import operators comply with the legal requirements with respect to plant health. An increase of this indicator thus implies an improvement in the plant health state in Belgium.
✅	**E**asy to monitor: Controls are performed by the FASFC. Data are then centralized within the FASFC.
✅	**R**obust.

Results:

Year	Number of samples	Indicator = % compliance	Change compared to preceding year (in %)	Limit
2015	570	80.2%	+2.6%	Not applicable
2014	279	78.1%	+4.3%	
2013	335	74.9%	-11.7%	
2012	520	84.8%	-8.1%	
2011	363	92.3%	+4.1%	
2010	326	88.7%	-	

Trend: No steady trend can be observed between 2010 and 2015.

Goal: 100% compliant.

Additional information:

- All shipments entering the European Union via Belgium are presented at a Belgian border inspection post. These shipments first need to undergo a documentary check. After this, checks are made to ensure that the shipped goods tally with these documents. As a third step, a plant health check is carried out and a control sample may be taken. Sampling may be conducted within the scope of protective measures (as imposed by a decree of the European Commission) or the FASFC control plan.
- Controls carried out at the border inspection posts (BIP) such as Zaventem, Ostend and Bierset airports, and the Port of Antwerp for example. A first samples set is taken if symptoms are present, a second samples set is taken randomly and a third samples set is taken systematically.

PHI07: Regulated phytopathogenic viruses and viroids controls

Description: The annual percentage of compliant samples tested for regulated phytopathogenic viruses and viroids within the framework of the FASFC control plan.

Category: Control of plants/plant products.

✅	**R**elevance of the indicator: The presence on the Belgian territory of harmful regulated organisms can be extremely detrimental, economically speaking, to plants and plant products production. It is therefore essential to maintain/improve the plant health state by verifying the absence of these organisms.
✅	**A**ccepted: This indicator is a measurement of the presence of regulated phytopathogenic viruses and viroids within the Belgian plant production chain.
✅	**C**redible: An increase of this indicator, namely an increase of the percentage of compliant samples, demonstrates therefore the improvement of the plant health state in Belgium.
✅	**E**asy to monitor: Controls are performed by the FASFC. Data are then centralized within the FASFC.
✅	**R**obust.

Results:

Year	Number of samples	Indicator = % compliance	Change compared to preceding year (in %)	Limit
2015	494	99.2%	+0.3%	Not applicable
2014	361	98.9%	-0.1%	
2013	384	99.0%	+2.8%	
2012	971	96.3%	+3.1%	
2011	679	93.4%	+5.6%	
2010	259	88.4%	-	

Trend: Overall, a positive trend is observed between 2010 and 2015. It is principally between 2010 and 2013 that the state has improved. Between 2013 and 2015, a status quo can be observed. Between 2012 and 2015, the results show a high compliance.

Goal: 100% compliant.

Additional information: Samples taken in the context of import controls are excluded to avoid redundancy with PHI06.

PHI08: Regulated phytopathogenic bacteria controls				
Description: The annual percentage of compliant samples tested for regulated phytopathogenic bacteria within the framework of the FASFC control plan.				
Category: Control of plants/plant products.				
✅	**R**elevance of the indicator: The presence on the Belgian territory of harmful regulated organisms can be extremely detrimental, economically speaking, to plants and plant products production. It is therefore essential to maintain/improve the plant health state by verifying the absence of these organisms.			
✅	**A**ccepted: This indicator is a measurement of the presence of regulated phytopathogenic bacteria within the Belgian plant production chain.			
✅	**C**redible: An increase of this indicator, namely an increase of the percentage of compliant samples, demonstrates therefore the improvement of the plant health state in Belgium.			
✅	**E**asy to monitor: Controls are performed by the FASFC. Data are then centralized within the FASFC.			
✅	**R**obust.			
Results:				
Year	Number of samples	Indicator = % compliance	Change compared to preceding year (in %)	Limit
2015	3,241	96.6%	+3.0%	Not applicable
2014	2,707	93.8%	-2.0%	
2013	2,583	95.7%	+1.2%	
2012	2,585	94.5%	-1.6%	
2011	2,766	96.1%	-0.2%	
2010	2,580	96.3%	-	
Trend: No steady trend can be observed.				
Goal: 100% compliant.				
Additional information: Samples taken in the context of import controls are excluded to avoid redundancy with PHI06.				

PHI09: Regulated phytopathogenic fungi controls

Description: The annual percentage of compliant samples tested for regulated phytopathogenic fungi within the framework of the FASFC control plan.

Category: Control of plants/plant products.

✅	**R**elevance of the indicator: The presence on the Belgian territory of harmful regulated organisms can be extremely detrimental, economically speaking, to plants and plant products production. It is therefore essential to maintain/improve the plant health state by verifying the absence of these organisms.
✅	**A**ccepted: This indicator is a measurement of the presence of regulated phytopathogenic fungi within the Belgian plant production chain.
✅	**C**redible: An increase of this indicator, namely an increase of the percentage of compliant samples, demonstrates therefore the improvement of the plant health state in Belgium.
✅	**E**asy to monitor: Controls are performed by the FASFC. Data are then centralized within the FASFC.
✅	**R**obust.

Results:

Year	Number of samples	Indicator = % compliance	Change compared to preceding year (in %)	Limit
2015	1,375	98.2%	-0.1%	Not applicable
2014	1,250	98.2%	+0.9%	
2013	1,153	97.4%	-0.3%	
2012	1,097	97.7%	-0.1%	
2011	968	97.8%	+4.7%	
2010	637	93.4%	-	

Trend: Overall, a positive trend is observed between 2010 and 2015. A major improvement has occurred from 2010 to 2011. Later on the trend is less stable. Between 2011 and 2015, the results show a high compliance.

Goal: 100% compliant.

Additional information: Samples taken in the context of import controls are excluded to avoid redundancy with PHI06.

PHI10: Regulated phytophagous or xylophagous insects controls

Description: The annual percentage of compliant samples tested for regulated phytophagous or xylophagous insects within the framework of the FASFC control plan.

Category: Control of plants/plant products.

✅	**R**elevance of the indicator: The presence on the Belgian territory of harmful regulated organisms can be extremely detrimental, economically speaking, to plants and plant products production. It is therefore essential to maintain/improve the plant health state by verifying the absence of these organisms.
✅	**A**ccepted: This indicator is a measurement of the presence of regulated phytophagous or xylophagous insects within the Belgian plant production chain.
✅	**C**redible: An increase of this indicator, namely an increase of the percentage of compliant samples, demonstrates therefore the improvement of the plant health state in Belgium.
✅	**E**asy to monitor: Controls are performed by the FASFC. Data are then centralized within the FASFC.
✅	**R**obust.

Results:

Year	Number of samples	Indicator = % compliance	Change compared to preceding year (in %)	Limit
2015	209	35.9%	+37.6%	Not applicable
2014	184	26.1%	-64.1%	
2013	738	72.6%	-22.0%	
2012	606	93.1%	+20.2%	
2011	31	77.4%	+74.2%	
2010	27	44.4%	-	

Trend: No steady trend is observed between 2010 and 2015. Highly fluctuating indicator.

Goal: 100% compliant.

Additional information: Samples taken in the context of import controls are excluded to avoid redundancy with PHI06.

PHI11: Regulated phytophagous or xylophagous nematodes controls

Description: The annual percentage of compliant samples tested for regulated phytophagous or xylophagous nematodes within the framework of the FASFC control plan.

Category: Control of plants/plant products.

✅	**R**elevance of the indicator: The presence on the Belgian territory of harmful regulated organisms can be extremely detrimental, economically speaking, to plants and plant products production. It is therefore essential to maintain/improve the plant health state by verifying the absence of these organisms.
✅	**A**ccepted: This indicator is a measurement of the presence of regulated phytophagous or xylophagous nematodes within the Belgian plant production chain.
✅	**C**redible: An increase of this indicator, namely an increase of the percentage of compliant samples, demonstrates therefore the improvement of the plant health state in Belgium.
✅	**E**asy to monitor: Controls are performed by the FASFC. Data are then centralized within the FASFC.
✅	**R**obust.

Results:

Year	Number of samples	Indicator = % compliance	Change compared to preceding year (in %)	Limit
2015	2,120	99.3%	+0.2%	Not applicable
2014	2,425	99.1%	-1.3%	
2013	2,361	97.8%	-0.6%	
2012	2,155	98.4%	-0.7%	
2011	2,119	99.1%	+0.6%	
2010	1,279	98.5%	-	

Trend: Overall, a positive trend is observed between 2010 and 2015. The results show a high compliance.

Goal: 100% compliant.

Additional information: Samples taken in the context of import controls are excluded to avoid redundancy with PHI06.

Appendix 4: RACER criteria applied to the plant health indicators.

Based on MANCP (2015).

Relevant	Is the indicator used closely linked to the objective to be reached, namely representing the state? *The whole of the indicators must be representative for the entire chain considered.* *Linked to the objectives (e.g. strategic, operational, policy or any other standards).*
Accepted	Is the indicator accepted by all stakeholders? *The set of indicators should be understood and agreed by the stakeholders involved.*
Credible	Is the indicator credible? *Unambiguous, easy to interpret and transparent.* *The indicator consistently produces the same result, based on reliable data.* *Unambiguous relationship between an increase or decrease of the indicator on the one hand, and an improvement or a deterioration of the overall state on the other hand.*
Easy to monitor	Is the indicator easy to monitor? *Based on easily obtainable, high-quality and unbiased data, providing a user friendly management tool.* *Measurable on a quantitative data basis and capable of rendering evolutionary trends over certain periods of time.* *Indicators that are difficult to monitor should be avoided where possible.*
Robust	Will the indicator continue to be usable and not subject to misunderstandings / manipulation? *Robust indicator is capable of performing under a wide range of conditions, i.e. is not sensitive to changes in the broader environment of the data/indicators.* *Specific indicator is affected by the underlying processes to be measured, but not affected by other processes.* *Sensitive indicator follows closely any changes in the underlying process to be measured.* *Unambiguous indicator is not open to more than one interpretation.* *The indicator has already been measured over a long period of time, and is expected to be further followed up during many years to come.*