Final meeting of the technical working group for the EMAS sectoral reference document on best environmental management practice in the agriculture – crop and animal production sector

Minutes of the meeting

Brussels, 23-24 June 2014

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The views expressed are purely those of the authors and may not in any circumstances be regarded as stating an official position of the European Commission.

Joint Research Centre

Contents

1 INTRODUCTION

The European Commission's Joint Research Centre (JRC) is developing a sectoral reference document on best environmental management practice in the agriculture – crop and animal production sector. The document will describe best environmental practices that farmers can implement to minimise their environmental impact.

The elaboration of this document is part of the European Commission's work to implement the EU Eco-Management and Audit Scheme (EMAS) Regulation[1]. EMAS is a voluntary framework for companies and other organisations to evaluate, report and improve their environmental performance. Within this framework, the EU decided in 2009 to develop Sectoral Reference Documents (SRDs) on Best Environmental Management Practice for a small number of priority sectors. These are documents that EMAS registered organisations must take into account when assessing their environmental performance, but can also be used by others looking for guidance on how to improve their environmental performance. The agriculture – crop and animal production sector is one of the priority sectors for which these documents are developed. Further information on this background is available in the JRC report "Development of the EMAS Sectoral Reference Documents on Best Environmental Management Practice"[2] and on the following website: http://susproc.jrc.ec.europa.eu/activities/emas.

For the development of the agriculture SRD, the JRC established a European technical working group (TWG), comprising experts in different aspects of environmental sustainability within the sector. The TWG assists the European Commission in identifying the best practices to be described, and then validate the final findings. Two meetings of the technical working group were held: the first one on 14-15 October 2013 (kick-off meeting) and the second one on 23-24 June (final meeting), both in Brussels. This report describes the discussions and conclusions drawn at the final meeting[3].

The goal of the final meeting was to refine the list of best practices and draw conclusions on environmental performance indicators and benchmarks of excellence. Bangor University supported the JRC in the development of a draft background report which was sent to the TWG members a few weeks prior to the meeting.

2 OPENING OF THE WORKSHOP

The JRC opened the session and welcomed the participants. After a brief explanation of the meeting procedures, an introduction to the workshop and overall project was given. The meeting agenda (attached in Annex 1) was presented and agreed on by the participants. The TWG members introduced themselves and summarised their experience in environmental sustainability in agriculture

[1] Regulation (EC) 1221/2009 of the European Parliament and of the Council of 25 November 2009 on the voluntary participation by organisations in a Community eco-management and audit scheme (EMAS), repealing Regulation (EC) No 761/2001 and Commission Decisions 2001/681/EC and 2006/193/EC, OJ L 242/1, 22.12.2009

[2] Available on-line at: http://susproc.jrc.ec.europa.eu/activities/emas/documents/DevelopmentSRD.pdf

[3] The chapters are presented in the order in which the discussions were held rather than their numerical order i.e. chapter 3 on sustainable farming appears at the end.

and their up-to-date contribution to the development of the SRD (the list of participants is attached in Annex 2). It was agreed to use first names to refer to the different TWG members and the same convention is adopted in these meeting minutes.

3 PURPOSE AND GOALS OF THE MEETING

During the first session, the JRC presented the legal basis for the development of the SRDs, the meaning of BEMP and the workflow for the finalisation of the agriculture SRD. After this introduction, the JRC outlined the goal of the TWG final meeting, which was essentially to draw conclusions on environmental performance indicators and benchmarks of excellence. Moreover, the meeting aimed at refining the list of best practices, identify gaps and information needs and obtain feedback and inputs to finalise the document.

4 INTRODUCTION TO THE CONCEPT OF ENVIRONMENTAL PERFORMANCE INDICATOR AND BENCHMARKS OF EXCELLENCE

The JRC introduced the concept of environmental performance indicator as a specific expression that allows measurement of an organisation's environmental performance.

The SRDs focus on sector-specific environmental performance indicators, i.e. indicators that go beyond the six general core indicators described in the EMAS Regulation, which can apply to all kinds of organisations (in the following key environmental areas: energy efficiency; material efficiency; water; waste; biodiversity and emissions). Sector-specific environmental performance indicators can be defined at different levels: at the level of the whole organisation or company, at the level of a certain site, or at the level of a specific process or activity.

Indicators can be relevant and useful at all these levels, but the main focus is on the process/activity level since this level allows for better and more meaningful comparability across organisations and against benchmarks. Benchmarks of excellence instead reflect exemplary environmental performance. Benchmarks of excellence, however, do not simply refer to the best of the best but, as a rule of thumb, to the performance of the ten, or the 10% to 20%, best performers within the sector overall; or within a good or best performing organisation of the sector.

The benchmark of excellence can be derived from a frequency distribution of a quantified environmental performance indicator or, when this is not possible, they can simply be a yes or no criterion or a percentage of implementation of a certain technique. Benchmarks of excellence are used to provide information to users of what is potentially achievable and to form an opinion on whether an organisation/process is performing well.

5 ENVIRONMENTAL PERFORMANCE INDICATORS AND BENCHMARKS OF EXCELLENCE FOR THE AGRICULTURE – CROP AND ANIMAL PRODUCTION SECTOR

5.1 Soil quality management (chapter 4)

Chapter scope

Healthy soils underpin agricultural production. Maintaining good soil quality is critical for resource-efficient farming. Soil itself is a resource, so its degradation represents one component of resource inefficiency. But fundamentally, soil degradation leads directly to inefficient use of other resources, such as fertilisers, in agricultural production, and damage to surrounding environmental resource including water bodies. In literature several are the authors that demonstrate the key role of soils in the delivery of ecosystem services such as flood regulation, water quality regulation, climate regulation and provisioning (agricultural production), amongst many others.

As a general comment, organic farming practitioners in the TWG remarked that all of the BEMPs covered in this chapter and more would be encompassed by the adoption of organic standards.

BEMP 4.1: Assess soil fertility and physical condition

It was suggested to add adequate skills and training of farm workers as an element of best practice. Nigel to provide information from the UK pig sector.

Regarding the Environmental performance indicators (EPI), soil organic matter content (%) is only a meaningful indicator for non-organic soils; it could be complemented by organic matter balance (+/-), with an aim to at least reach balance (no loss). In addition, pH could be used as an EPI. Katarina will provide information on soil organic matter testing and Klara on nutrient soil testing.

During the discussion it was decided that this BEMP should focus only on the physical condition of the soil, while the part related to fertility should be moved to BEMP 5.1. In light of this, the new title of the BEMP will be "Assess soil physical condition".

Regarding the benchmarks, the TWG stressed that annual field inspections could be inadequate as there are cyclical phenomena linked to crop rotation which can alter the result; it might be more relevant to specify timings (e.g., N measurement after a harvest) and stress the importance of an annual report with field observations and measurements taken throughout the year at different points on the field.

Soil bulk density and organic matter analysis testing could be done every 5 years. Yield measurement was considered too remote to be included as a benchmark (any effect measurable on yield values would already indicate serious degradations in soil conditions).

At the end of the discussion, it was agreed that the benchmark of excellence for this BEMP will be:

- A *soil management plan* should be implemented for the farm that incorporates:
    i. annual report for signs of erosion and compaction based on field inspections;
    ii. soil bulk density and organic matter analysis at least every 5 years;
    iii. implementation of concrete actions for soil quality and organic matter

BEMP 4.2: Organic matter amendments on cropland

Members of the TWG recommend stressing more the importance of maintaining/increasing the organic matter content in soil, therefore the title of the BEMP will be amended as "Maintain/improve soil organic matter on cropland". Moreover, the important benefit of multi-year grass leys on improving the soil organic matter content was discussed. Katarina will provide information on benefits of keeping grass leys for longer than 1 or 2 years.

TWG members agreed that the EPI should be more discriminating in terms of nutrients brought in by manure: beyond carbon content, manure contains N, P and therefore there is a risk of over-fertilising (adding N and P together with carbon) when spreading.

TWG members stressed that the benchmark should mention crop rotation, and it was suggested to include in the benchmark the practice of keeping the soil covered between crops (maintaining the organic content).

At the end of the discussion, it was agreed that the benchmark of excellence for this BEMP will be:

- Ensure all arable soils on the farm receive organic matter inputs from e.g. manures, catch/cover crops, composts, or digestates at least once every three years, and account for all organic nutrient inputs in nutrient management plans.
- Establish grass leys for 1-3 years (see also BEMP 6.4).

BEMP 4.3: Maintain soil structure

It was agreed to merge BEMPs 4.1 and 4.3 in the same BEMP, moving elements related to soil fertility and 'structure' from BEMP 4.3 to 4.1. Furthermore, the part on nutrients should be moved from BEMP 4.3 to BEMP 5.1 "Field nutrient budgeting".

TWG members suggested that a new EPI could be introduced in BEMP 4.1 including biological indicators for soil structure e.g. earthworm count (which is relatively affordable). Rolf-Jan could provide literature and contacts on earthworms in soil.

BEMP 4.4: Soil drainage management

There was broad consensus that the BEMP could be reformulated from a more global point of view (e.g. catchment area), as drainage has a much broader impact on downstream-lying land (it can cause flash flooding). "Drainage management" (drainage or on the contrary drain blocking) is an approach to reduce flooding which should be encouraged: "smart drains" could be a benchmark as they go beyond good practice. Nigel will provide info on smart drainage systems.

During the discussion it was recommended that the EPI on soil moisture status should be redefined also including an element on timing (i.e. season) of the measurement. Alternatively the EPI could just emphasise visual inspection for ponding.

TWG members mentioned that controlled drainage also links to pesticide and fertiliser loss control.

At the end of the discussion, it was agreed that the benchmark of excellence for this BEMP will be:

- Maximise natural drainage through careful management of soil structure; maintain the effectiveness of existing drains; install new drains where appropriate on mineral soils
- Minimise drainage of peat soils, and soils where there is a high risk of increased nutrient transfer to water via drainage

5.2 Nutrient management planning (chapter 5)

The first issued raised during the discussion was the title of the chapter and it was agreed to simplify to "Nutrient Management".

Chapter scope

Overall, the chapter focuses on the maximisation of nutrient use efficiency and some TWG members mentioned that it presents some overlaps e.g. with manure use and with whole farm nutrients. The aim of the chapter is to find the trade-off between the economic optimum and the environmental optimum, seeking the maximum yield. The focus of the chapter is on cropland but it can also apply to pasture.

BEMP 5.1- Field nutrient budgeting

The amount of information available on this topic varies widely according to Member States. The UK seems to have a lot available in this respect. Some of the tools in UK are indeed best practice, such as fertiliser manual RB209, but hardly transferable as such; others based on concepts rather than numerical values, such as KNS[4] could be more portable. Rodney will provide info on a German nutrient budgeting tool.

Some participants suggested merging BEMPs 4.1 and 5.1, linking the aspects of micronutrients and pH previously discussed. A further EPI could include the replacement of artificial fertiliser by manure.

A participant proposed that the benchmark could be reformulated to include an absolute limit value on nutrient surplus (e.g. 100 kg/ha N, 10 kg/ha P). However, during the discussion, it was agreed not to introduce an absolute numerical limit. It should be noted that for reference the draft report contains some values on Nutrient Use Efficiency.

The scope of the BEMP could also distinguish or focus on cropland, as calculations for grazing are much more difficult (Koos will provide grass height monitoring information from real farms). The benchmark should allow the flexibility to be used at the level of the whole farm rather than the field where it may be impractical. Basically, while the first benchmark was considered practical, the second benchmark was felt to be difficult to implement as such and a reformulation ("estimated" nutrient surplus/efficiency rather than "calculated") was proposed.

At the end of the discussion, it was agreed that the benchmark of excellence for this BEMP will be:

- The maximum fertiliser nutrients applied do not exceed those required to achieve the agronomic optimum crop yield, after fully accounting for crop-available nutrients supplied by: (i) organic amendments; (ii) soil nutrient supply; (iii) crop residues.
- Nutrient surplus or nutrient use efficiency is estimated for nitrogen, phosphorus and potassium for individual crop- or grassland- management parcels.

BEMP 5.2 - Crop rotation for efficient nutrient cycling

This BEMP presents the benefits of including nitrogen-fixing crops such as legumes to reduce the need for artificial nitrogen fertilisation.

Regarding the achieved environmental benefits, according to the TWG members, the wording should be amended to "reduce *the impact of* fertiliser manufacture". As farmers may still apply fertilisers, it could be envisaged to account for the reduction in nitrogen fertiliser use arising from the use of cover crops. In fact, participants highlighted the important role not only of legumes but also of catch and cover crops and intermediate crops such as clover in nitrogen fixation. The EPI could therefore be

[4] Kulturbegleitende N_{min}-Sollwert-System

more specific (i.e. grass / clover / leys) and also include metrics applicable to grassland e.g. "30-40% of clover on permanent grassland".

At the end of the discussion, it was agreed that the benchmark of excellence for this BEMP will be:

- All grassland and crop rotations include at least one legume crop and one break crop over a five year period

BEMP 5.3 - Precision application

The benefits of this BEMP are similar to those of the previous one; the objective is to reduce the use of (nitrogen) fertilisation. It was proposed to slightly amend the title to "precision nutrient application".

According to the TWG, the key aspect highlighted in the BEMP should be the reduced use of artificial nitrogen fertiliser. This is part of a more global approach consisting in (from most to least preferable) using nitrogen-fixing and intermediate crops, applying organic fertilisers, and applying artificial fertilisers. The TWG stressed that manure can also be over-applied, therefore the BEMP should also include manure contribution alongside synthetic. However, in terms of calculation it should be kept in mind that bioavailability of synthetic fertilisers is initially much lower compared to manure.

During the discussion, it was pointed out that the wording "precision" should be clarified as it is usually interpreted by farmers as e.g. using GPS localisation to differentiate treatment in different parts of a field (which could in fact, in this case, also be relevant but not the core of the technique).

The TWG noticed that the applicability of urea injection is restricted to temperate conditions presenting low volatilisation. Other techniques, rather than injection, can also be used (not necessarily best practice) to reduce ammonia volatilisation, such as Agrotain® products. It was agreed that the benchmark could be extended to other nitrogen fertilisers rather than solely focussing on urea. In terms of economic applicability, it should be noted that urea is used because it is one of the cheapest sources of nitrogen but having to inject it could make it less viable and e.g. compete with other application techniques.

Regarding feasibility, it is assumed that NUE will be possible to calculate (it is also in use for other BEMPs), if not at field level at least at the level of the whole farm.

At the end of the discussion, it was agreed that the benchmark of excellence for this BEMP will be:

- Nutrient surplus or nutrient use efficiency is estimated for nitrogen, phosphorus and potassium for individual crop- or grassland- management parcels

BEMP 5.4 - Lower impact synthetic fertilisers

The BEMP focusses on the upstream (production) impact of artificial fertilisers as well as their application.

Some members of the TWG felt that the data supporting N_2O losses was too incomplete and recent to base the recommendation for a best practice (even the Gothenburg protocol on long range transboundary emissions convention has been unsuccessful in tackling ammonia emissions).

The TWG suggested that the benchmark on urea application has to be put into context, since urea already achieves roughly $1/5^{th}$ of emissions compared to nitrate-based fertilisers, representing already significant gains. Since urea is widely recognised as less detrimental than nitrate based fertilisers, the message should not be to put people off using urea. Insisting on injection might be too heavy handed even for a benchmark.

It was therefore suggested to amend the benchmark wording to broaden to "low ammonia emission application": including injection but also e.g. coating

At the end of the discussion, it was agreed that the benchmark of excellence for this BEMP will be:

- Mineral fertiliser used in the enterprise must not have given rise to manufacturing emissions exceeding 3 kg CO_2^e per kg N, which must be demonstrated in an openly reported calculation provided by the supplier.
- Employ low ammonia emission application of fertilisers.

5.3 Soil preparation and crop planning (chapter 6)

BEMP 6.1 - Matching tillage operations to soil conditions

This BEMP includes monitoring erosion due to the effects of tillage.

The TWG mentioned that the EPI on direct erosion measurement is difficult to quantify, so the focus would probably be better on the other proxies indicated to look for signs of erosion (such as gulleys, etc.). This could also be the object of a specific benchmark. Moreover, it was recommended to stress more that erosion is reduced when crops are present in the field.

Regarding the material used, concerns were voiced that the data source for the report is controversial (GLASOD study) and there is more recent data available (see book from John Boardman, "Soil erosion in Europe", 2006).

As wind erosion is becoming more prevalent, visible signs should be monitored in detail. There are also other indirect methods, as erosion is linked to organic content of the soil. For instance affordable methods such as earthworms count have proven to be effective. It was therefore suggested to add a biological indicator among the EPIs.

At the end of the discussion, it was agreed that the benchmark of excellence for this BEMP will be:

- Fields with peat soils must be kept covered with long-term grass ley. Soil tillage on peat soils to reseed the ley may only be carried out after a period of at least 5 years.

BEMP 6.2 - Minimise soil preparation operations

It was noted that in particular for organic agriculture, absolute zero-tillage is very difficult to achieve as to some extent light tillage is used for weed control. However, there is vast experience with very drastically reduced tillage and the use of chisel ploughs which do not turn the soil. Therefore, the TWG recommended including in the BEMP the reduced tillage operations.

Moreover, farming systems using no herbicide or synthetic nitrogen inputs should be accommodated in the BEMP. More generally, for all types of farming, a mention of trade-offs with the use of crop protection products can be included.

The BEMP could mention the avoidance of redundant tillage.

At the end of the discussion, it was agreed that the benchmark of excellence for this BEMP will be:

- Inversion tillage is avoided through use of e.g. direct seed drilling, strip tillage and reduced tillage (chisel plough).

BEMP 6.3 - Mitigate tillage impact

According to the TWG, techniques presented in this BEMP, though relatively easy to implement, appear good practice but are still not widespread. Reduced tillage is not suitable for all soils, but is still widely underused.

"Tyre pressure" should be reformulated to reflect the progress of modern machinery, where e.g. types of tyres or reduced traffic with GPS planning can also reduce impact; a suggestion was made to replace "Low pressure tyres" by "Low ground pressure impact ".

BEMP 6.4 – Crop rotation for soil protection

It was noted that the title of the BEMP was restrictive as crop rotation offers a broad range of environmental benefits beyond soil protection and nutrient management, including the promotion of biodiversity or pest control leading to a reduction in pesticide use and improved water efficiency. There is not only a temporal but a spatial dimension to crop rotation as e.g. two adjacent fields planted with the same crop will be more prone to erosion than with different varieties.

A question was raised of whether this BEMP could include biofumigation.

Participants highlighted the bias towards Northern European contexts (e.g. rapeseed), when more focus should be put on practice in the South as well. Some experts thought the benchmarks were too specific, hampering this broader applicability; therefore it was suggested to remove the included restrictive list of break crops. The reference mentioned in the report (2005 DEFRA report on "Controlling soil erosion") is a good, if often ignored, source for state-of-the-art information mostly applicable across climate types.

While "winter" dates are not very specific, the BEMP should remain as broadly applicable as possible including to a variety of climate conditions, therefore the need was not felt to include date ranges. The TWG suggested also including an indicator % of soil coverage during winter.

The 30-40% range for legume cover, while ambitious for many climates, will be low in some circumstances; therefore it was removed from the benchmark of excellence.

At the end of the discussion, it was agreed that the benchmark of excellence for this BEMP will be:

- On farms with a cereal-dominated crop rotation, break crops must be included in the crop rotation. In a seven-year crop rotation, at least two years must be used for break crops. In a six-year crop rotation or shorter, at least one year must be used for a break crop.
- Farms alternate crops cultivated in neighbouring fields to introduce and increase spatial diversity in fields.
- Select early maturing varieties of crops (e.g. maize) to harvest before the wet season and to facilitate cover crops establishment.

BEMP 6.5 – Establish cover and catch crops

As a general comment on the applicability of the practice the TWG noted that in some specific conditions, farmers and regional water managers may be against cover crops, on account of the perceived increase in evapotranspiration that they cause. At the other end of the spectrum some countries mandate minimum levels of cover over the winter e.g. in Sweden less than 5% can stay uncovered, going well beyond the benchmark. The main advantage of having cover and catch crops is to provide protection against soil erosion / nutrient leaching.

Participants debated at length the pros and cons of adopting cover crop protection in the specific example of winter corn (maize). While there is a narrow window of opportunity to cover the ground shortly after maize harvest in winter, this can be widened by sowing in the rows *before* the harvest, expanding the opportunity to use cover crops. This also provides wind protection for the cover seeds. In many parts of Europe there are severe issues of post maize harvest erosion and runoff caused by compaction, as well as nitrate leaching, which are exacerbated by the late dates of harvest into the Autumn. This would advocate in favour of harvesting early to broaden the window for crop covering; however there is a tradeoff, as farmers choose late-harvesting varieties precisely because they have higher yield. Koos will provide data on timing of sowing cover crops.

The TWG highlighted that in this BEMP and the related benchmark, the distinction between "catch crops" and "cover crops" is slightly artificial as they can be one and the same variety but used for different purposes, against erosion or nutrient leaching.

The benchmark could therefore be reformulated mentioning "cover crops / catch crops". Moreover, it was decided to move the information about cover crops providing 25% ground cover by early winter to offer effective protection against erosion into the operational data.

At the end of the discussion, it was agreed that the benchmark of excellence for this BEMP will be:

- Provide evidence of a full assessment of the potential to integrate cover crops/catch crops into cropping plans, providing justification for any land left bare over winter

5.4 Grass and grazing management (chapter 7)

Scope

The TWG discussed the possibility of introducing a BEMP in the chapter related to soil compaction and erosion, and the suitability of (e.g. heavy cattle) breeds to soil, but was considered difficult as very dependent on the context.

BEMP 7.1 - Efficient grazing uptake

This BEMP aims to reduce the amount of wastage in the use of feed materials generated on the farm, thereby reducing feed imports and virgin material resource use.

The TWG mentioned that it may be necessary in the benchmark to specify that the 90% figure is calculated on dry matter uptake. It should also be mentioned that only the grazing season is concerned, not an average over the whole year. It should also be made clear whether the figure includes silage (ensiled grass); in this case the title would be changed to "grass utilisation" or "grass management" rather than grazing.

Discussions focussed also on whether it might be necessary to modulate the benchmark according to the quality of the grass, and also to differentiate between dairy and meat products.

Some participants noted that the promotion of grazing if not carefully managed can have conflicting environmental effects e.g. overgrazing in upland habitat. Similarly, farmers want to extend the grazing period well beyond the peak protein availability season in the spring, which can be damaging to the soil. On the other hand grassland is a hotspot of biodiversity which should also be acknowledged (link with following BEMP). Finally, compaction of grass could be added as EPI.

It was agreed that a reformulated benchmark would be proposed taking these comments into account. Therefore, the new benchmark could be:

80% grass dry matter uptake by grazing animals during the grazing period.

BEMP 7.2 - Managing HNV meadows

This BEMP is primarily focussed on farms practicing extensive grazing. It is also to be considered in the broader context of EMAS where biodiversity is a core indicator.

Regarding the EPI on number of species the TWG stressed that this is in practice very difficult to measure (in existing environmental schemes this is very hard e.g. for verifiers to certify). Therefore, proxy measures would probably have to be considered, ideally broadly applicable. Nitrogen fertiliser input could be proposed as a useful proxy, moreover, some publications consider e.g. hedges and

buffer strips. "Species diversity" should be used as EPI rather than "species abundance" to capture this aspect. Kate will provide info on simple indicators for biodiversity (counting species per m^2).

An additional EPI could consist in measuring cutting frequency and the date of first cut.

The term "meadows" was deemed to be imprecise, therefore it was suggested to use "grassland" instead. The new BEMP will therefore be "Managing HNV grassland".

Regarding the biodiversity action plan, it is often subject to regulation or codes of conduct and should be set up with input from stakeholders e.g. NGOs. Marion can provide references from programme set up by Heumilch and Nick will provide examples of best practice with local NGO engagement in the UK.

It was agreed to maintain the benchmark and extend it to include an aspect of collaboration with local experts (e.g. authority / NGOs). Therefore, at the end of the discussion, it was agreed that the benchmark of excellence for this BEMP will be:

- A biodiversity action plan established with local biodiversity experts is implemented on the farm, to maintain and enhance the number and abundance of locally important species.

BEMP 7.3 - Pasture renewal and legume inclusion in permanent pasture and lays

This BEMP is primarily aimed at intensive farms rather than extensive (see previous BEMP).

The TWG suggested that the EPI on Nitrogen use efficiency could be extended to include Phosphorus as well. An additional indicator could be based on the biodiversity of plant species in the pasture.

Participants in the meeting pointed out that promoting biodiversity can also have negative effects, i.e. could promote diversification based on sowing exogenous species which is destabilising for the land (tends to produce mild short-term yield improvement followed by decreases). Kate will send a paper on species diversity (by Pywell).

The BEMP should recommend pasture renewal only when required, instead, over-seeding should be discouraged as it is now presented. Moreover, the BEMP should present reseeding as an option to be used when justified.

During the discussion it was commented that the benchmark could not be applicable everywhere as it is proposed, and could lack ambition in many contexts. As a metric it was suggested to focus on ground coverage rather than seed weight.

At the end of the discussion, it was agreed that the benchmark of excellence for this BEMP will be:

- Pasture renovation (e.g. over-seeding) is employed to maximise forage production, maintain high legume coverage and introduce other flowering species.

BEMP 7.4 - Efficient silage production

This BEMP is linked to BEMP 7.1 (silage / grass uptake). The TWG pointed out that for this BEMP the dry matter value will have to be estimated rather than measured. Moreover, the D-value in itself is not a sufficient indicator (farmers will aim to minimise it anyway); the silage production process and its structure (e.g. improvement of nitrogen levels) is also a significant factor in the assessment of the environmental impact. Meanwhile, there is an optimum to be sought as the D-value can be too low but also too high. Koos will send some info on silage D value.

Participants stressed that in its current formulation the BEMP could be construed as incentivising the harvest of grassland to sell to dairy farms; whereas it is intended for integrated farms with grasslands and its own animals. The BEMP will therefore be modified accordingly and also focusing on how best to produce silage from the environmental point of view.

BEMP 7.5 - Nitrification inhibitors

The relevance of this BEMP which had already been controversial at the kick-off meeting was discussed. It was debated whether it made sense as a standalone BEMP or was too specific.

The use of nitrification inhibitors is controversial (e.g. have been abandoned in New Zealand) and should be presented with caveats. The technique could be useful in the broader context of improving NUE in general. As a standalone technique it is not good environmental practice, as it is most relevant only with severe problems of over-nitrification; but then in that case the use of inhibitors, while addressing the symptoms, does not address the root cause (of over-fertilisation, farm animal density too high…) and therefore might contribute to worsening environmental impacts in the long run.

It was agreed to remove the technique but to dedicate a specific section to it in the broader chapter on NUE optimisation.

5.5 Animal husbandry (chapter 8)

Scope

The focus of this chapter encompasses large intensive animal production facilities but also smaller (poultry etc.) installations which are below the threshold to be covered by the Industrial Emission Directive (IED).

BEMP 8.1 - Locally productive breeds/hybrids

The issue of breeds deserves special attention here as it is not covered by the IED. Some participants felt that the proposed benchmark was very ambitious and unrealistic.
The discussion highlighted that usually there is a trade-off between productivity and the use of rare/locally adapted breeds which tend to be less productive and slower growing but develop other qualities. There are many criteria when selecting breeds for production: robustness, longevity, grass intake and utilisation efficiency of grass (e.g. for cattle) while broader environmental concerns and biodiversity are less of a breeding goal.
Although developed mostly based on cattle the BEMP should be applicable to other farm animal types i.e. for pig/poultry/goat/sheep. Marion can provide contact at *ProSpecieRara* for further information.
It was proposed to change the title of the BEMP to "locally adapted breeds (hybrids)" and to distinguish the benchmark between locally adapted (hybrids) and rare breeds.

At the end of the discussion, it was agreed that the benchmark of excellence for this BEMP will be:

- ≥ 50% of the animal population consist of locally adapted breeds (hybrids).
- ≥ 5-10% of the animal population consist of rare breeds.

BEMP 8.2 - Nutrient budgeting for livestock farms

The JRC relayed comments received from the unit B1 in DG Environment in charge of nitrates – target values would depend on the impacted water body; it does not necessarily make sense to define standard across Europe.

Regarding the proposed benchmark of excellence, it was generally found to be too high and needing qualifications. The indicator should be calculated as an average over several (i.e. 3-5) years. Data is available and shows that much lower rates than 100 kg/ha/yr are achievable (e.g. the average surplus is ~50kg in the whole of Austria). Some participants simply proposed a benchmark of excellence at balance (0 surplus), but this was deemed impractical.

A more broadly applicable approach would be to define the surplus relative to plant needs (e.g. 10%, Urs will provide some examples). Some participants even proposed a relative approach whereby the nitrogen surplus would be moderated by the livestock density per land surface area.
At the end of the discussion, it was agreed that the benchmark of excellence for this BEMP will be:

- Farm level nitrogen surplus is maximum 10% of farm nitrogen requirements.

Moreover, it was agreed that an analogue benchmark could be set for phosphorus:

- Farm level phosphorus surplus is maximum 10% of farm phosphorus requirements.

BEMP 8.3 - Control of Nitrogen excretion

The TWG noticed that the use of CP (crude protein) as an EPI is now considered obsolete. In fact, with monogastric animals, the availability of protein to the gut matters. Therefore, nowadays it is recommended to look at additive amino acids which increase the availability of protein in the gut, reducing the amount fed (resulting in less nitrogen in manure and lower impact of feed production).

The TWG highlighted that the animal's nutrition can also be closely tailored to the production phase; it was proposed to include consulting for dietary advice as a benchmark.

At the end of the discussion, it was agreed that the benchmark of excellence for this BEMP will be:

- Farms obtain nutritional advice on optimised phase feeding.

BEMP 8.4 - Dietary reduction of enteric CH_4

A potential pitfall of the current BEMP was mentioned, as it might encourage the artificial fattening of e.g. beef (favour corn feed over grazing) which is known to have detrimental effects in terms of ecosystem impacts and animal welfare (corn fed cows have significantly shorter life expectancy and fertility). Calving rate should also be taken into account as EPI and Urs will provide info.
A more sensible approach to achieve the objectives of the BEMP would be to select animals which are better able to utilise feed, and whose health also benefits.
A hierarchy of practice from best to worst could be established, e.g. maximise use of grass from farm / try to improve digestibility of grass / finally use imported feed (and if so use green procurement criteria, cf. following BEMP).
Finally it was noted that this BEMP was mostly delivering public-goods benefit so the benefits to farmers should be investigated and put forward.

BEMP 8.5 - Green procurement of feed

It was acknowledged by the TWG that this BEMP would be largely prospective today because of the low availability of low impact feed, but it should be kept in. For instance, the availability of RTRS (Round Table on Responsible Soy)-certified soy in the UK is close to nil. Moreover, the BEMP should stress more the aspect of minimising the environmental impact of chosen feed.
The discussion also covered the potential relevance of including a criterion on locally produced feed; although a lifecycle assessment (e.g. carbon footprint) might not be always in favour of local sources, other environmental benefits should be put in balance.

At the end of the discussion, it was agreed that the benchmark of excellence for this BEMP will be:

- Imports of soy- and palm-based feeds are minimised, and where used, 100% of such feeds are certified (with e.g. RTRS) not to originate from areas of recent land use change

BEMP 8.6 - Maintain animal health

The core discussion centred on whether this topic should be broadened to include animal welfare dimensions e.g. by broadening the benchmark to include an animal welfare plan. It was debated

whether animal welfare constituted an environmental impact strictly speaking and therefore within the scope of EMAS, with participants on both sides of the argument. While it could not be a core item in EMAS, it should be kept if themes developed have an impact on animal welfare. On this note economic impacts are also to be considered even if they are not the primary focus of EMAS. If a metric was to be included on animal welfare, it would have to be a composite index based e.g. on the "five freedoms". Qualitative factors such as the observation of animal behaviour, indications of good welfare could be included.

Regarding feed conversion efficiency (FCE), there are investigations ongoing on benefits from selective breeding to improve conversion efficiency and welfare. Due to economic constraints, farmers favour a diet with a lower environmental burden but in doing so they lose some of the FCE (e.g. rapeseed, human food refuse). Therefore, FCE alone is not a representative indicator; it should be used to monitor health of herd rather than to increase FCE at all costs.

A suggested additional indicator could be based on the use of medication and in particular antibiotics (occurrence of treatment per head over the year). Medicine use should be minimised except for pain relief. Another approach is to take into account whether there is a preventive herd health plan in place on the farm. This would on average deliver a reduction of 30% in antibiotic use on farms (Urs to provide background data).

At the end of the discussion, it was agreed that the benchmark of excellence for this BEMP will be:

- The farm systematically monitors animal health and implements a preventative healthcare programme that includes at least one preventative visit per year by a veterinary surgeon

BEMP 8.7 - Herd/flock profile management

The main idea behind this BEMP is to reduce methane emissions from enteric fermentation. Some participants advocated maximising production to maximise resource efficiency. Others warned against going as far down the productivity route as the proposed benchmark. The discussion also raised the issue of rare/ancient breeds which usually take longer to mature (but provide other benefits). The TWG suggested to further develop this BEMP mentioning exception for rare breeds, and factors such as seasonality or market impacts.

5.6 Manure management (chapter 9)

BEMP 9.1 - Efficient housing

Ammonia emissions were recognised as a key environmental impact tackled by this BEMP.
More specific details on housing features were proposed during the discussion, e.g. the reduction of urine exposure to atmosphere with a slatted floor. The BEMP should focus on cattle housing otherwise the UN Economic Commission for Europe document could be used to introduce best practices for pig and poultry.
As alluded to in the previous chapter, the TWG mentioned that there is a trade-off between animal welfare and environmental impact.

At the end of the discussion, it was agreed that the benchmark of excellence for this BEMP will be:

- Minimise the duration of cattle housing and install a grooved floor, roof insulation and controlled natural ventilation systems to animal housing.

BEMP 9.2 - Anaerobic digestion

The discussion mainly focused on the chance that AD plants can be designed and operated without crop input. Many participants felt that this ban would not be practical since the operators need a

regular composition of input (to guarantee some stability in the digestate), e.g. the C/N ratio. As a side note it was commented that the recent enthusiasm for biogas raises concerns that supplies will not be stable in the future; in particular with dwindling meat production the feedstock is not assured.
It was agreed that in the BEMP the origin of co-digestion material (crops, food, feed) should be specified. Moreover, in the benchmark of excellence the % of crop derived digestate should be added.

BEMP 9.3 - Separation of slurry / digestate

Debates centred on the benchmark value of 100% slurry separation; in this case, it was highlighted that the limit is extremely high and not practical. It was therefore suggested to reword the benchmarks removing 100% and adding "as needed".
The TWG mentioned that the BEMP should present also some other separation techniques rather than only mechanical separation.

At the end of the discussion, it was agreed that the benchmark of excellence for this BEMP will be:

- Slurry or digestate arising on dairy, pig and poultry farms is separated as needed into liquid and solid fractions that are applied to soils in accordance with crop nutrient requirements and soil organic matter requirements.

BEMP 9.4 - Slurry storage

The panel remarked that a gap seems to exist between this BEMP and the previous, hence the need for providing information either in this BEMP or in an extra BEMP on slurry processing e.g. acidification (yields ammonium reduction), slurry cooling, solidification.
The TWG suggested to include in the benchmark alternative slurry coverage technologies such as clayball, leca, hexacover. Moreover, it was debated whether the benchmark could include techniques not yet on the market (such as German best-in-class) to drive up the market, which is on the borderline of the common benchmark of excellence. The JRC will investigate more at what techniques can be included in the benchmark.

BEMP 9.5 – Appropriate solid manure storage

It was suggested to add as EPI the % of solid manure stored according to this BEMP. Moreover the BEMP should also indicate a minimum distance between the manure storage and water course.

At the end of the discussion, it was agreed that the benchmark of excellence for this BEMP will be:

- Solid manure fractions are composted or stored for at least three months in batches with no fresh manure additions.
- Solid manure stores are covered and located away from surface water courses, with leachate collected and recycled through the farm manure management system.

BEMP 9.6 – Injection slurry application and manure incorporation

Regarding the description, experts stressed that some precautions are required for the application of raw manure (e.g. cannot apply raw manure on growing crop / need at least 6 months between application of manure and harvest for horticultural crops). It should be specified that only shallow injection is in the scope as deep injection has detrimental environmental side effects.
According to the TWG a dimension which should be incorporated in the BEMP is the timing of the application – as 20% of ammonia can already be lost in the first 4 hours, it is preferable to specify a maximum of 2 hours for the application.

At the end of the discussion, it was agreed that the benchmark of excellence for this BEMP will be:

- In accordance with nutrient requirement of the crop, 100% of high N slurries applied to land are applied via shallow injection, or trailing shoe or banded application, and 100% of high ammonium manures applied to bare arable land are incorporated into the soil as soon as possible and in any case within two hours.

BEMP 9.7 – Injection slurry application to grassland

The TWG recommended to cross-reference this BEMP to the chapter 5 (BEMPs for nutrient management).

At the end of the discussion, it was agreed that the benchmark of excellence for this BEMP will be:

In accordance with nutrient requirement of the crop, 100% of slurries applied to land are applied via shallow injection, or trailing shoe or banded application.

5.7 Irrigation (chapter 10)

The proposed BEMPs presented for this chapter were: minimize irrigation demand, irrigation management, and efficient and controlled techniques. Some TWG members highlighted that efficiency of irrigation systems is an important aspect but this chapter should be cross referenced to chapter 4 (soil quality management) since water holding capacity in soils must be increased. Among the environmental benefits, improved aquatic ecosystems thanks to appropriate irrigation practices should be mentioned, while reduced use of crop protection products should probably be removed, unless evidence is provided in the description of the BEMP.

The TWG suggested restructuring the chapter, using the information already available but presenting them in a different way. The new proposed structure was:

- Agronomic methods: tackle issues such as soil management vs evaporation, selection of adapted crops, calculation of water needs, scheduling and water quality.
- Optimisation of irrigation delivery (e.g. drip irrigation, low-P sprinklers): describe how to choose the best irrigation delivery system depending on the crop, climate, water availability etc.
- Management of irrigation systems (distribution and storage): how to avoid water losses and improve water storage capacity.
- Efficient & controlled strategies i.e. including deficit irrigation.

Other remarks from the TWG were:

- Fertigation could be mentioned in combination with drip irrigation since there are examples available; Rodney can provide a paper with more information on this;
- The use of efficient and controlled techniques has also the environmental benefit of reducing overexploitation of water resources and their salinisation;
- When developing the BEMP on efficient and controlled strategies, it should be taken into consideration that there is a need for farmers to have water meters in order to be able to measure their water irrigation consumption.
- In the BEMP on agronomic methods, it may be appropriate to add a section on filtering and water quality management which is used for watering crops.

- When mentioning water footprint, it should be clear if referred to grey, blue or green, according to their definition.

5.8 Avoiding and optimising the use of crop protection products (chapter 11)

The TWG suggested rewording the title to "Environmental performance indicators and benchmarks of excellence for crop protection products".

BEMP 11.1 – Minimise use of crop protection products

Crop protection products cause a range of environmental consequences and the TWG in general agreed on the need to reduce their use.

The first remark from the TWG was the need to stress more the optimized use of crop protection products. The title of the BEMP can therefore be amended to "Optimising and reducing the use of crop protection products". It was mentioned that measures described in the BEMP should go beyond national action plans for crop protection products and the aim should also be continuous improvement (i.e. reduce their use). However, since national action plans are very different all over Europe, it is difficult to establish a common benchmark. The aspect which was mostly discussed was the need for farmers to put in place a dynamic crop protection management plan which includes: crop rotation, operators training, biological pest control and only finally, if needed, use of crop protection products with precise application. The TWG recommended developing the BEMP according to this sequence of steps. Moreover, a suitable EPI could be treatment frequency while the kg of active ingredient is not a useful indicator.

BEMP 11.2 – Crop protection products selection

The TWG highlighted that when selecting crop protection products their side effects and the resistance of crops are important aspects. It was added that there are databases available which allow choosing crop protection products based on their side effects. An important aspect of this BEMP should be, when choosing crop protection products, farmers should aim at reducing their use. Moreover, farmers should assess the actual need of treatments for crops on the field and avoid not required applications. The environmental performance indicator $Kg_{active\ ingredient}$/ha/yr should be amended as in the previous BEMP. According to some participants, the implementation of warning systems to inform neighbours when famers plan to use crop protection products could be considered a benchmark of excellence.

BEMP 11.3 – Natural predators in protected horticulture

The first comment from the TWG pointed out the need to reword the title to "natural enemies" which would allow describing techniques aiming at biological control of plants' health, not only for horticulture but also for field crops. In this BEMP, natural enemies which have relevance to habitat

creation could be described, while in BEMP 11.1 a range of measures aimed at reducing the use of crop protection products could be included (e.g. bio-products). According to some member of the TWG, in this BEMP the aspect of improving natural habitats which would increase the number of natural predators should be stressed.

5.9 Protected horticulture (chapter 12)

BEMP 12.1 – Waste heat and renewable energies use in northern European horticulture

The TWG highlighted that the use of renewable energies in protected horticulture cannot be restricted only to northern Europe, therefore this aspect could be removed from the title. However, in the applicability section, reference to the wider application in northern Europe can be mentioned. Information in this BEMP could be just integrated with any best practice about cooling of greenhouses in southern Europe, which is usually done either by washing the greenhouse or by natural ventilation. Moreover, reference to optimum design of greenhouses could also be added.

BEMP 12.2 – Water management in southern European protected horticulture

The main remark of the TWG was about removing from the title reference to southern European horticulture, since areas subject to water stress are present also in northern Europe. Close-loop water systems are good examples which could be included in this BEMP and Daniele can provide some information and a proposal for the benchmark.

Among the EPI the nutrient losses in soil could be added and reference to water productivity should also be mentioned.

BEMP 12.3 – Waste management in horticulture

The TWG highlighted that in this BEMP polytunnels are not mentioned while their presence in the farm should also be considered. In addition, there was general agreement on the need for farmers to collect all their waste, separate according to the nature of the material and then appropriately dispose (e.g composting for organic fraction). Decontamination of waste plastic is a task which normally is not carried out by the farmers but later by the waste processors.

At the end of the discussion, it was agreed that the benchmark of excellence for this BEMP will be:

- All waste must be collected, separated and properly disposed, organic fraction composted, and no waste sent to landfill.

5.10 Sustainable farm and land management (chapter 3)

BEMP 3.1 – Strategic farm management

Participants focused on the fact that in general LCA for farms misses important aspect of sustainability such as biodiversity and soil quality that cannot be ignored. Normally, farmers need support from farm advisers or should join a group of farmers in order to perform an assessment of their performance and establish a strategic management plan.

At the end of the discussion, it was agreed that the benchmark of excellence for this BEMP will be:

The farm is managed according to a strategic management plan that:

- considers a time period of at least five years
- integrates economic, social and environmental considerations *[to be reworded in order to become more performance-oriented]*
- considers ecosystem services delivery in a local, regional and global context using appropriate, simple indicators described throughout this report

BEMP 3.2 – Embed benchmarking on environmental management

The TWG stressed the appropriateness of this BEMP and raised some concerns about the training of all the staff, which could be sometimes problematic especially for temporary employees. Moreover, the benchmark of excellence proposed seemed reasonable to the TWG but it could be more ambitious and the JRC will investigate the possibility of quantifying the ambition level.

BEMP 3.3 – Catchment sensitive farming

The TWG mentioned the need to modify the title of the BEMP in order to be more general and not to refer only to catchment sensitive areas. The new title of the BEMP will be "Landscape water quality management". Among the measures which should be mentioned, the farmer should also identify sings of soil erosion. Moreover, the TWG recommended to remove the proposed benchmark on establishing buffer zones which are appropriate is some areas but not in others.

At the end of the discussion, it was agreed that the benchmark of excellence for this BEMP will be:

- Catchment sensitive farming is implemented via all applicable BEMP techniques described in this report (Table 3.5)
- Farmers work collaboratively with neighbouring farmers and river basin managers from relevant authorities to minimise risk of water pollution, for example through the establishment of strategically located integrated/constructed wetlands

BEMP 3.4 – Biodiversity conservation and habitat management

Participants firstly agreed on rewording the title to "Landscape scale biodiversity management". It was then found unclear what the rationale for the measures included in this BEMP and in the BEMP 7.2 (Managing HNV grassland) was, therefore the JRC will further investigate and clarify this aspect.

The TWG highlighted that the presence of bio-corridors could be an interesting indicator for this BEMP while, rather than yearly N application rate, the % of natural habitat compared to the total surface of the farm could be introduced as EPI. The benchmarks of excellence could be set at minimum 15% of natural habitat in the farm (Urs will provide info on these figures and their feasibility), however it is important to consider not only the "quantity" of natural habitat but also the "quality".

Another important aspect to consider in this BEMP, according to the TWG, is the need for farmers to firstly identify the natural environments available in his/her farm (Urs will send info on how farmers can identify habitats). Afterwards they should also be able to assess the invasive species present.

At the end of the discussion, it was agreed that the benchmark of excellence for this BEMP will be:

- A biodiversity action plan is implemented on the farm, to maintain and enhance the number and abundance of locally important species.

Moreover, the JRC for this BEMP will elaborate a proposal for the benchmarks based on further investigation and information provided by Urs.

BEMP 3.5 – Energy and water efficiency

As an overarching comment, the TWG immediately noticed the excessive number of plans that farmers have to implement according to the document developed herein. Therefore the JRC should reflect on the need to harmonise all of them in just one or simplify the way they are presented introducing some templates.

At the end of the discussion, it was agreed that the benchmark of excellence for this BEMP will be:

- Energy management plan revised every five years, to include:
  i. Mapping of direct energy consumption across major energy-consuming processes;
  ii. Mapping of indirect energy consumption via fertiliser and animal feed consumption;
  iii. Benchmarking energy consumption per hectare or animal unit;
  iv. Energy efficiency measures;
  v. Renewable energy measures.
- Water management plan revised every five years, to include:
  i. Mapping of direct water consumption by source across major processes;
  ii. Benchmarking water consumption per hectare or animal unit;
  iii. Water efficiency measures;
  iv. Rainwater harvesting

BEMP 3.6 – Waste management

The TWG suggested to remove the reference to a waste management plan but to keep the other measures (digest or compost organic waste, separate waste streams, document compliance with all relevant regulation). Moreover, suitable waste storage solutions should be described in the BEMP.

At the end of the discussion, it was agreed that the benchmark of excellence for this BEMP will be:

- Reduce, re-use, recycle and recover waste arising so that no waste is sent to landfill.

BEMP 3.7 – Engage consumers with responsible production and consumption

The TWG highlighted that measures such as open days, public access to land and footpaths, information panels etc. improve the awareness of the public about responsible production and consumption. These measures, which are applicable for small and big farms, should also be described in the BEMP. Regarding the direct selling of products by farmers, social media and internet websites should be mentioned as new valid tools. Finally, the TWG recommended that as EPI the % of products sold on a defined market would be more appropriate than % of products sold directly to consumers.

6 OTHER REMARKS

At the end of the meeting, the TWG discussed about the next steps in the development of the SRD and plans for its dissemination with a view to reaching the broadest possible section of the target audience, i.e. farm operators and farm consultants. The importance for the final document to have a clear and simple index and executive summary was highlighted, since these are the first parts readers will be looking at. The TWG also recommended having an interactive webpage presenting the BEMPs and their applicability according to different parameters (e.g. type of farms, location etc.). Moreover, in order to increase the dissemination of the document, networks of associations would be the preferred channel. Special focus should be also given in targeting young farmers and students but this would involve the translation of all or some parts of the final report into the different EU languages.

ANNEX 1 – AGENDA

23 June 2014		
Arrival and registration of participants		09:30 – 10:00
Opening and welcome		10:00 – 10:30
Introduction of experts		10:30 - 10:45
1- Purpose and goals of the meeting		10:45 - 11:00
2- Introduction to the concept of Environmental Performance Indicator and Benchmark of Excellence		11:00 - 11:30
3- Environmental performance indicators and benchmarks of excellence for soil quality management	Chapter 4	11:30 - 12:30
Lunch Break		12:30 - 13:45
4- Environmental performance indicators and benchmarks of excellence for nutrient management planning	Chapter 5	13:45 - 14:45
5- Environmental performance indicators and benchmarks of excellence for soil preparation and crop planning	Chapter 6	14:45 - 15:45
Coffee Break		15:45 - 16:15
6- Environmental performance indicators and benchmarks of excellence for grass and grazing management	Chapter 7	16:15 - 17:15
7- Environmental performance indicators and benchmarks of excellence for animal husbandry	Chapter 8	17:15 - 18:15
Wrap-up and close of the day		18:15 - 18:30

24 June 2014		
Arrival and registration of participants		08:45 - 09:00
Opening of the day		09:00 - 09:15
8- Environmental performance indicators and benchmarks of excellence for manure management	Chapter 9	09:15 - 10:30
Coffee Break		10:30 - 11:00
9- Environmental performance indicators and benchmarks of excellence for irrigation	Chapter 10	11:00 – 11:45
10- Environmental performance indicators and benchmarks of excellence for avoiding and optimising the use of crop protection products	Chapter 11	11:45 - 12:45
Lunch Break		12:45 - 14:00
11- Environmental performance indicators and benchmarks of excellence for protected horticulture	Chapter 12	14:00 - 15:00
12- Environmental performance indicators and benchmarks of excellence for sustainable farm and land management	Chapter 3	15:00 - 16:30
Conclusions		16:30 - 17:30
Wrap-up and close of workshop		17:30 - 18:00

ANNEX 2 – LIST OF PARTICIPANTS

Name	Surname	Organisation	Country
Barbara	Amon	Leibniz Institute for Agricultural Engineering	DE
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John	Boardman	Environmental Change Institute, University of Oxford	UK
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Henriette	Christensen	Pesticide Action Network Europe	EU
Olivier	Diana	DG Agriculture (European Commission)	EU
Georg	Vogl	VNU - German Assoc. for Env. Mgmt. Professionals	DE
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Caroline	Drummond	LEAF (Linking Environment And Farming)	UK
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