Final report

for the CORE Organic II funded project

'ProPIG'

Farm specific strategies to reduce environmental impact by improving health, welfare and nutrition of organic pigs

Period covered: 1.11.2011-31.12.2014

Project acronym:	ProPIG			
Title:	Farm specific strategies to reduce environmental impact by improving health, welfare and nutrition of organic pigs			
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Projects website:
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Post project summary suitable for web publication

ProPIG consists of 9 partners in 8 countries (AT; CH; CZ, DE; DK; FR, IT; UK) with the aim to assess and improve animal welfare and environmental impact of organic pig farming:

- **Three husbandry systems**: indoor with outside run (IN) / partly outdoor (POUT) / outdoor (OUT) were defined and compared.
- **Standard Operating Procedures ('SOPs')** were created for Feed- and Soil Sampling and the process of assessment and feedback ('Health and welfare planning').
- **Animal welfare assessment protocols** were developed based on WelfareQuality® and CorePIG. Together with questions regarding environmental impact, nutrition and economy, these were integrated into an
- **Automated Recording and Feedback Software Tool** ('PigSurfer'= PIG **SUR**veillance, **FE**edback and **R**eporting), a software enabling on-farm data collection and immediate feedback (including presentation of data as benchmarking) using a tablet computer.
- **Farm visits**: After repeated **observer training**, three visits were carried out, in AT (16 farms), DE (16), DK (11) CH (9), CZ (1), FR (4), IT (9) and UK (8). During the first visit the farmer was interviewed, animals assessed, medicine and productivity records collected and feed and soil samples taken. Results were discussed with each farmer and farm specific goals and measures were agreed during the second visit. Using 'PigSurfer' during the final visit, it was possible to assess animal health, welfare, nutrition and feed the results back immediately to farmers as 'farm plans' including benchmarking across all 74 pig farms.

As a result two practical tools for further use by farmers and advisors were created:

- A 'Catalogue of improvement strategies' (COIS) for animal welfare challenges was developed based on expert opinion as well as farmers strategies. This was transferred into a '**Handbook for Farmers**', a hard cover ring-binder version, which allows practical application on farm.
- Furthermore a '**Decision support tool for environmental impact**' (EDST) was created in form of an interactive spreadsheet, which identifies areas of possible improvement regarding environmental impact through a structured questionnaire, suggests measures which might be beneficial and provides information on where to find more detailed resources.

Generally based on the parameters assessed, it was shown, that a high level of **animal health and welfare** was found in most farms, with few parameters, which should be improved across all systems (e.g. vulva deformation). When comparing the three husbandry systems, OUT weaners and fatteners had better health regarding respiratory problems and diarrhoea and OUT sows less MMA and lameness, with POUT having some advantages as well over IN (e.g. lameness of sows). Regarding productivity, losses of piglets did not differ across systems, mortality of IN fattening pigs was lower than in POUT and their feed conversion rate was better.

Life Cycle Assessment (LCA) of global warming potential (GWP) was influenced mainly by feed of fattening pigs and variation within a husbandry system was higher than between systems, indicating that in all systems good values can be achieved.

Regarding **acidification** (AP) **POUT** were better than IN, and regarding **eutrophication** (EP) POUT were better than OUT.

Three clusters were identified, a 'high, 'medium' and 'lower' with similar numbers of husbandry systems in all three of them.

The three systems did not differ regarding **N balances.** After clustering, N import from feed purchase was identified as main influencing factor. IN were significantly better than POUT/OUT regarding **P balances**.

No significant relationship between health, welfare and environmental impacts was found when comparing the LCA clusters with an 'animal health and welfare score' ('%GOOD'), individual animal based parameters or correlations between AP/EP/GWP and the '%GOOD.

Farm specific strategies were evaluated by farmers' opinion and assessing within-farm improvement in measured criteria over 12 months. The median number of aims per farm was 2 (1 to 4), with fertility, nutrition, health and lesions most commonly addressed. In total 74.8 % of measures were partly/completely implemented and 81.6 % of goals were partly/completely achieved.

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Pre-project summary

Robust and competitive organic pig production needs to encompass low environmental impacts and good animal health and welfare. In theory, improving animal health and welfare reduces environmental impacts through decreased medicine use, improved growth rates and feed conversion efficiency. However, as data on environmental impacts are scarce, the extent of such improvement has never been verified on working farms.

In organic pig production, health and welfare improvements must be implemented through preventive approaches, optimal disease management and innovative systems regarding outdoor areas. This poses a challenge to the farms. Together, organic regulations, different national welfare regulations and different building traditions have promoted the development of a variety of housing systems, outdoor rearing and management strategies across the EU. The relative environmental impacts of these have not been quantified. This diversity offers real potential to aid improvement, if the 'best' can act as role models for others, which might be more effective than adapting practice derived from experimental systems. This project includes data recording on organic pig farms, calculations of nutrient balances and Life Cycle Assessment for several contrasting scenarios and the development and evaluation of farm specific improvement strategies.

At the beginning of the project husbandry systems will be defined, (e.g. outdoor / partly outdoor / indoor with outside run). After development of on-farm assessment protocols a cross-sectional survey and a prospective cohort study will be carried out on about 25 farms of each system across eight different European countries. Environmental impacts will be assessed using both Life Cycle Assessment and calculations of nutrient balances at farm and outdoor area level. Animal health and welfare will be evaluated from outcome measures of clinical scoring and selected behavioral parameters. Results will be fed back to farmers as benchmarking reports, based on which the farmer will decide farm specific goals and strategies to achieve these. As an outcome all farms create their individual health, welfare and environmental plan, which will be reviewed after one year to allow continuous development.

The relationship between health, welfare and environmental impacts will be examined using factor analysis and multiple correspondence analyses. Thereby, farms can be grouped based on common housing and management characteristics, and groups be compared regarding outcome parameters. Furthermore, the effect of farming system on health, welfare and environmental impact will be assessed with multivariate models, taking into account the climatic conditions. The farm specific strategies will be evaluated by assessing within-farm improvement in measured criteria over 12 months. Dissemination activities will include the development of a decision support tool for improvement of environmental impact and a summary of successful improvement strategies (codes of practice). These will be presented as a booklet and training material for organic pig farmers and advisors, which will be introduced during national courses.

The proposed project will take a holistic approach and combine several key objectives: management of outdoor areas, disease prevention, optimizing nutrition and innovative interacting strategies for improvement to support extension services.

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1. Main results, conclusions and fulfilment of objectives

1.1 Summary of main results and conclusions

During ProPIG on-farm data were collected twice from 74 organic pig farms regarding health, welfare, productivity, feeding, economy and environmental impact using specifically developed Software (PigSurfer). These detailed data were used to implement strategies for improvement on all involved farms based on 'farm reports' including benchmarking. Furthermore this information together with scientific expertise and farmers experience contributed to the development of a 'Handbook for Farmers' and an 'Environmental Decision Support Tool', which is now available for pig farmers across Europe. Additionally the data collected were analysed to compare the three main husbandry systems of organic pigs in Europe (indoor, partly outdoor, outdoor) regarding environmental impact, animal health and welfare and their interaction.

ProPIG consists of 9 partners from 8 countries (AT, CH, CZ, DE, DK, FR, IT, UK), building on the previous CoreOrganic project 'CorePIG' consortium but with a different partner in DE and expanded to include the Czech Republic (2 partners: Bio-I and IAS). Sweden (JTI), who was originally a partner (and WP leader) in ProPIG, had to withdraw due to lack of funding. However, Eva Salomon (JTI) offered the contribution of her expertise including own funding of travel expenses to the workshops and was actively involved in the expert group on environmental impact (soil).

All countries participated in all three work packages. On-farm visits were carried out in all countries, ranging from one farm in CZ to 16 in DE/AT, depending on the number of organic pig farms and funding available. The fields of expertise needed were mostly covered by the partners, however, several additional experts were involved, either from the partner institutions or from outside. Those experts were included (either in general or on a national level) due to their expertise regarding areas which were less well covered by the consortium (e.g. LCA). They contributed different amounts of work, either supervising the PhD- / Master student in connection to ProPIG (e.g. Werner Zollitsch, BOKU; Stefan Hörtenhuber, FIBL) or acting as experts, when discussing potential improvement strategies (e.g. Denmark: the research group Epidemiology and Management, AU-ANIS; Germany: Ralf Bussemas, BAT).

The consortium formed three expert groups:
1. animal health and welfare
2. environment (LCA/soil)
3. improvement-strategies

For **communication** between partners and expert groups a 'Dropbox Folder' was established and managed by the coordinator to share documents such as protocols, photos, lists of farms ('Farm planner') and more. Additionally to emails, web meetings were held between the coordinator and all three Workpackage leaders on a regular basis (on average 4 meetings per year).

Immediately after the start of the project the whole group met at the **First Workshop and Expert Meeting in Austria/Vienna,** at BOKU 9.-11. November 2011, in order to:
- Discuss the structure/organisational matters (e.g. consortium agreement)
- Introduce and discuss WP 1-3 (by WP leaders)
- Summarise (inter)national related projects (e.g. ICOPP)
- Plan dissemination activities (common articles/website/national stakeholder meeting)

Working in Groups – Development of parameters/strategies:
- Animal health and welfare – animal scoring sheet (Annex 1)
- Environmental impact (e.g. vegetation cover sheet – Annex 1)
- Economy and nutrition
- Improvement strategies ('Catalogue of Improvement Strategies')

On the last day, an excursion to a typical Austrian organic pig farm was organized to relate and discuss the first draft of parameters to the situation on farm.

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Using the results from this workshop all expert groups started to work on lists of parameters (animal health and welfare, nutrition, environment, economy) and a supplementary dictionary was established to define unclear terms (see also Annex 1).

The parameters were integrated into '**PigSurfer**' (=PIG **SUR**veillance, **FE**edback and **R**eporting) a Software tool (Handbook: Annex 3) developed by Andreas Strack (Germany) enabling via tablet pc:

- on-farm data collection: interview (e.g. management, land use, nutrition), productivity and medicine records, animal based assessment
- benchmarking those data with existing data (either same country/same system/across countries)
- immediate creation of a 'farm report' (Annex 3)

The first version was pilot tested in Austria (for indoor systems) and Italy and Denmark (for outdoor systems) and a few adaptations were made.

The **Second workshop and Expert meeting** was held in France/Rennes, at INRA, 2.-4. May 2012:

- General assessment procedure and introduction to 'PigSurfer'
- Further discussion of interview and records; health and welfare parameters;
- Dictionary (for definition of terms used in PigSurfer) and further steps regarding parameters (validity, references, hypothesis);
- Qualitative interview regarding expectations of farmers (Results: Annex 6)

Furthermore a **training session** on animal based assessment was carried out using pictures and videos. The assessment was then applied on an outdoor pig farm, where additionally environmental assessment (e.g. vegetation cover) was discussed. During the next day, two additional farms were visited and groups of sows/weaners/finishers were assessed by all on-farm observers independently in order to monitor the effects of training (Inter-observer repeatability (IOR) 1).

As observer agreement was not satisfactory for all parameters, observer training and tests were repeated in three further sessions (for easier logistics; IOR 2):

28. -29.6. 2012: Re-Training and Repeatability Testing in Austria of AT; DE; CH
16. -17.7. 2012 Re-Training and Repeatability Testing in Austria of CZ and IT
10.-12. 10. 2012 Training and Repeatability Testing in DK of DE, DK and UK

The **Third workshop and Expert meeting** was held in Fossano, **Italy** from 21. -24. May 2013 to discuss first results, strategies for data analysis, development of the 'Environmental decision support tool', the 'Catalogue of improvement strategies', dissemination and the next round of farm visits. Furthermore two Italian pig farms were visited with another discussion of parameters and assessment of animals (25 sows, 13 weaners groups, 10 finishing groups) by on-farm observers to calculate IOR3. The **first steering group meeting** was held to discuss relevant topics (e.g. Training of observers/methods to ensure inter-observer reliability).

As agreement of observers with the gold standards was still not satisfactory, it was agreed to hold two more sessions (IOR4) in Austria and Denmark

6.-8.8 2013: Re-Training and Repeatability Testing in Austria of AT; DE, CH, CZ, IT,
19.-20.8.2013: Training and Repeatability Testing in Denmark of DK and UK

The **Fourth workshop and Expert meeting** was held in Frick/Switzerland at FIBL on 20th and 21st January 2014, where the main aim was to present first results (on animal health and welfare, GHGE, improvement strategies), discuss next steps for further analysis (e.g. economic impact, soil, feeding) and work together on tools such as the "Handbook for Farmers" and the Environmental decision support tool. Experts from FIBL gave presentations on environmental impact and layout for 'Handbook for Farmers` and a member of the Swiss funding body participated at the meeting.

The **Fifth Workshop and Expert meeting including an Open Meeting** for related projects was held in Newcastle, UK at Cockle Park (Univ. Newcastle) from 22nd to 24th of September 2014. The first day was dedicated to discussion of results (animal health and welfare, environmental impact and improvement strategies), tools developed ('Handbook for farmers',

Environmental decision support tool) and publication and dissemination of those. Furthermore the second day was an 'open day' where results from ProPIG (e.g. P balances, PigSurfer, Feed) were shared and discussed along five related projects with three invited external experts (ANIPLAN; AssureWEL, Improve-P, ICOPP; LowInputBreeds). On the final day an excursion was organised to visit a ProPIG farm, where specific issues connected to outdoor pig farming and animal health were discussed.

During **several research stays intensive exchange** between several partners happened and joined work on assessment tools and data analysis was performed:

- Research stay of R. Brandhofer(BOKU) at INRA for methods of LCA
- Research stays of G. Rudolph (BOKU) at FLI during three periods (11.11. - 27.11.2013, 6.1. - 19.1. and 12.5. - 28.5.2014) working on analysis of AHW and ENV data.
- Joint data collection in France by M. Holinger (FIBL) with A. Prunier (INRA).

<u>Inter observer reliability (IOR) test results</u>

Observer training and agreement tests were implemented before each of the two rounds of farm visits. Each training and test (T1a and T2a) was repeated once (T1b and T2b) in three sessions because observers did not reach sufficient agreement in the respective first training. In general, prevalence of problems to be scored was so low that only agreement and no correlations could be calculated (median gold standard prevalence across parameters and sessions: 0 %, n = 17 to 62 per parameter).

At least three observers did not reach ≥ 70 % agreement for the parameters lesions and swellings in fatteners and sows (T1b and T2b) and low BCS in sows (T1b) which is why these parameters were excluded from analysis. For all other parameters agreement of each observer with the gold standard ranged from 70 to 100 % with a median of 90.5 % at T1b and 75 to 100 % with a median of 100 % at T2b (details see appendix 10 - animal health, welfare and productivity manuscript).

Farm recruitment was carried out using various routes (farmer meetings, - journals, contacts at advisory bodies and farmer organisations). The following inclusion criteria were defined:

Table 1 Inclusion criteria for farms

must be	aim for	avoid if possible	do not include
converted to organic for at least 2 years (conversion 100% certified)	combined farrow-finish farms	farrowing only or finishing only farms	
	'typical' working organic pig farm	special needs persons farms, research and teaching farms	
	>20 sows in herd	<20 sows in herd	<10 sows in herd
	>100 finishing places (in those countries where finisher only farms cannot be avoided)	<80 finishing places (in those countries where finisher only farms cannot be avoided)	
	farms which fulfil all EU organic regulations	farms with obvious breaches to EU organic regulations	

During the **first farm visits** the following procedure was followed:

1. Introduction of ProPIG to farmer (using a ProPIG leaflet for farmers)
2. The qualitative questionnaire was carried out
3. Using PigSurfer, an interview was conducted (e.g. management, land use, nutrition) and productivity- and medicine records were collected (approx. 2-4 hours).
4. A representative number of animals was assessed (2-4 hours depending on herd size)
5. Feed samples (all countries, on all farms) were taken
6. Brief feedback to farmer and explanation of next steps

In August (3.8.2012) partners from AT, CZ, DE, UK were able to discuss first experiences from farm visits and JY Dourmad (FR) visited (31.8.2012) Austria to discuss and finalize the procedure of LCA evaluation and train the Austrian Master student.

For the **second visits** for each farmer a farm specific report was printed out from PigSurfer, covering a brief description of the farm and all relevant animal based parameters (for one

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example farm plan see Annex 3) benchmarked using data from all other farms of the same country (in CZ Austrian data were used).

The following procedure was suggested for the second visit:

- Try to include all people, working with pigs and additionally advisors/vets, if wanted by farmer
- Explanation of the process of 'Farm health and welfare planning' (Standard Operating procedure ('SOP') improvement):
  - The plan reflects the situation in comparison to other farms, no judgment
  - The farmer should identify one to three goals for the herd
  - The researcher is there to facilitate/support the process
  - The farmer should have a pen to make notes during the discussion and write down the goals and measures in the end onto the 'Farm report summary'.
- Summary of first visit using the farm report
- Detailed discussion of all goals and measures to achieve those, using the 'Catalogue of Improvement Strategies' as a basis
- Definition of goals and measures
- Collection of soil samples (AT 4 farms, CH 3, CZ 1, DE 3, FR 4, IT 8) using 'SOP soil sampling'. In DK and UK due to winter conditions during farm visit 1 and 2 it was not possible to collect soil samples.

The **third visits** were carried out as a normal advisory visit would be performed, supported by PigSurfer, which enables data collection and feedback within a half day visit. In order to review also the previous 'farm plan' including implementation of measures and achievement of goals the farm plan from visit 2 was printed out in advance. Furthermore farm specific results from analysis of environmental impact (soil, LCA) were prepared to be able to discuss it with each farmer.

During the visit the same sequence as in visit one combined with visit 2 was followed:

1. Using PigSurfer, an interview was conducted (e.g. management, land use, nutrition) and productivity- and medicine records were collected
2. A representative number of animals was assessed (2-4 hours depending on herd size)
3. Calculation of collected data as benchmark with data from first visits of all other 74 farms with PigSurfer and printing of new 'Farm plan'
4. Qualitative Farmer Interview and explanation of LCA/soil results
5. Implementation of new 'Farm plan` following procedure from second visit and SOP

Summary of main results:

Three husbandry systems were defined and described- Indoor with outside runs (POUT), partly outdoor systems (POUT) and outdoor systems (OUT). The definition of these can be found in the description of Workpackage (WP1) as well as in Annexes 9a and 10.

Several tools for farmers and advisors aiming at farm specific surveillance and improvement were developed:

- **'PigSurfer`** for Surveillance, Feedback and Reporting of Animal health and welfare: Software
- **Handbook for Farmers** on Animal health and welfare: a ring binder booklet
- **Environmental Decision support tool**- a excel based decision support tool

Data regarding animal health and welfare (AHW) and environmental impact (ENV) as well as farm aims and improvement measures were collected on **74 farms** (AT: 16, CH: 9, CZ: 1, DE: 16, DK: 11, FR: 4, IT: 9, UK: 8), of which 34 were IN, 29 POUT and 11 OUT.

During the initial farm selection, farms with incomplete production chains (e.g. finishing farms) were paired with farms from whom they bought / to whom they sold pigs. These thus complete production chains (PC) were the units of observation for all ENV calculations.

For **analysis** in a first step all data were checked for plausibility and completeness and parameters with insufficient repeatability (e.g. lesions and swellings) were excluded from further analysis.

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The three husbandry systems (IN / POUT / OUT) were compared regarding animal health, welfare and productivity as well as environmental impact:

Animal health, welfare and Productivity (AHW)
Prevalence of AHW problems were compared at two levels using nonparametric tests: a) current location during assessment (indoor or outdoor), and b) system of the farm (indoor, partly outdoor, outdoor = IN, POUT, OUT, respectively).
Generally based on the parameters assessed, it was shown, that a high level of **animal health and welfare** was found in most farms, with few parameters, which could be improved across all systems (e.g. vulva deformation).
When comparing the three husbandry systems OUT weaners and fatteners had better health regarding respiratory problems and diarrhoea and OUT sows less MMA and lameness, with POUT having some advantages as well over IN (e.g. lameness of sows). Regarding productivity, losses of piglets did not differ across systems. Mortality of IN fattening pigs was lower than in POUT and their feed conversion rate was better.

Environmental impact
ENV analysis consisted of Life Cycle Assessments (LCA) regarding global warming potential (GWP), acidification (AP) and eutrophication (EP) potentials. Additionally, N and P balances were calculated for each PC. ENV results were compared between PC system (IN, POUT, OUT; nonparametric tests) and PC were clustered based on their LCA results.
Life Cycle Assessment (LCA) of global warming potential (GWP) was influenced mainly by feed, followed by direct emissions of animals. Furthermore, most emissions were generated in the fattening stage. Variation within a husbandry system was higher than between, indicating, that in all systems good values can be achieved.
- **POUT** were better than IN regarding acidification (AP), and regarding eutrophication (EP) they were better than OUT.
- **Three clusters** were identified, a 'high', 'medium' and 'lower' environmental impact, plus two clusters with one PC only. Numbers of IN, POUT and OUT PC did not differ between clusters.
- The three systems did not differ regarding **N balances**, after clustering N import from feed purchase was identified as the main influencing factor. IN were significantly better than POUT/OUT regarding **P balances**.

Relation between Animal health and welfare with environmental impact
Furthermore, AHW results were compared between LCA clusters (correlations, nonparametric tests). No significant relationship between health, welfare and environmental impact was found when comparing the LCA clusters with an 'animal health and welfare score' ('%GOOD'),
individual animal based parameters or correlations between AP/EP/GWP and the '%GOOD.
Farm specific improvement strategies were evaluated by farmers' opinion and assessing within-farm improvement in measured criteria over 12 months. The median number of aims per farm was 2 (1 to 4), with fertility, nutrition, health and lesions most commonly addressed. In total 74.8 % of measures were partly/completely implemented and 81.6 % of goals were partly/completely achieved.

Conclusions
ProPIG results indicated that most organic pig farms across Europe did encompass low environmental impacts and good animal health and welfare. The three main husbandry systems (IN/POUT/OUT) did not differ regarding GWP, however in other aspects of environmental results were inconsistent. Variation within system was much greater than differences between systems. Regarding animal health and welfare, OUT systems had advantages, whereas IN systems performed better regarding fattener productivity. The goal to reduce environmental impacts by improving animal health and welfare (e.g. decreased medicine use, improved growth rates and feed conversion efficiency) was followed, as farmers chose fertility/nutrition and health as the main topics for improvement and implemented the selected measures to a high degree. The consequences for environmental impact require a longer term assessment to take account of the delay in realised outcomes and seasonal influences. ProPIG did take a holistic approach and combined several key objectives: management, disease prevention, optimizing nutrition and innovative interacting strategies for improvement to support extension services.

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1.2 Fulfillment of objectives

'The aim of this project is to investigate the interaction of animal health and welfare, with nutrition and environmental impact and to create and disseminate a tool to improve both aspects of organic pig production'.

The developed software 'Pigsurfer' provides a solid basis to achieve the overall aim to investigate and improve animal health and welfare, nutrition and environmental impact as it includes: animal welfare (e.g. scan sampling of oral behaviour), health (e.g. MMA treatments), nutrition (e.g. thin sows, feed ration), and environmental impact (e.g. manure management). The possibility to summarise this information and feed results back to farmers as a farm report enables a discussion with the farmer to identify areas to improve. The potential measures to achieve those selected goals are compiled in the 'Handbook for farmers', which is a collection of measures based on expert opinion, literature and farmers' strategies. Furthermore the 'Environmental decision support tool' allows farm specific improvement of environmental impact including references and benchmarks.

The tools developed were not only successfully used for 74 organic pig farms within ProPIG, but are also available in several languages and can be used across Europe for (organic) pig farms of all three existing husbandry systems.

• *To identify animal environment interactions in the three different housing systems for organic pigs (outdoor / partly outdoor / indoor with outside run) across the European climate zones*

Even though numbers of farms in the different husbandry systems were not completely evenly distributed it was possible to compare either husbandry systems of pig categories or 'production systems' (breeding to finishing period). The hypothesis, that all three systems are similar when well-managed, was upheld regarding environmental impact (GHGE and N), while POUT systems had advantages regarding EP and AP and animal health and welfare was better for some aspects in OUT systems. One of the main influencing factors for environmental impact (feed conversion rate of fattening pigs) was better in IN systems.

• *To develop and implement farm specific strategies to reduce environmental impacts by improving health, welfare, nutrition and management of organic pigs*

Development and implementation of farm specific strategies was facilitated by PigSurfer, enabling a structured evaluation of the situation including benchmarking with other organic farms and within farm over the duration of the project. Farmers most frequently chose aims for improvements related to fertility (29), lesions (19) and nutrition (19) and chosen measures were frequently partly or fully implemented (74,8%).

• *To disseminate knowledge to national advisory bodies and farmers*

Information regarding results of ProPIG was provided to advisory bodies and farmers. All 74 participating farmers did benefit directly from the farm individual planning process, which was carried out twice within the project. Furthermore in several national farmer/advisor meetings information on ProPIG was (and will be) disseminated. This process will carry on once the Handbook for farmers is printed in several languages and the Environmental decision support tool is fully available.

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2. Milestones and deliverables status

Table 2 Milestones

No[1]	Milestone name	Planned delivery month[2]	Actual delivery month[2]	Means of verification
M 1.1	Identification / determination of housing and management systems to be assessed	5	5	Communication of decision to all participants via shared dropbox folder (WP1 protocols)
M 1.2	Assessment protocol for animal health and welfare and environmental impact	6	6	Protocols available to include into an automatic recording and feed back tool
M 1.3	Automatic recording and feedback tool (handheld benchmarking system)	8	8	Tool – 'PigSURfer' ready to be used on farm- first farm visits started in Project month (PM) 8
M2.1 (ab)	Observer training	8/20	12/19	1st and 2nd training completed, sufficient level of observer agreement reached
M2.2	Farm visit 1: assessment of animals and environment	13	18	1st farm visit completed in all countries
M2.3	Farm visit 2: feed back, implementation of improvement strategies	14	21	2nd farm visit completed Aims and measures agreed and documented in all farm reports
M3.1	Decision support tool for enviromental impact	20	35	Beta version of software ready to be tested during farm visit 3
M2.4	Farm visit 3: re-assessment for evaluation of improvement strategies	26	27	Final farm visit completed in all countries
M3.2	Improvement strategies for the farming system summarised as 'catalogue of imnprovement strategies - COIS'	30	38	'Code of practice' booklet ready for use
M3.3	Evaluation of improvement strategies	32	38	Internal summary report
M3.4	Dissemination / publication of 'catalogue of improvement strategies' during national training courses	36	38	Courses carried out

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[1] Please use the numbering convention <WP number>.<number of milestone/deliverable within that WP>. For example, deliverable 4.2 would be the second deliverable from work package 4.
[2] Measured in months from the project start date (month 1).

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Table 3 Deliverables

No[1]	Deliverable name and language	Nature[3]	Dissemination level[4] and link to the document	Planned delivery month[2]	Actual delivery month[2]
D3.1	Project Website (English)	Website	PU www.coreorganic2.org/Propig	6	9
D1.1	On-farm assessment protocols for animal health, welfare and environmental impacts (English)	Protocol	INT (Annex 1)	6	6
D2.1	Health, welfare and environmental plans for all farms (English/French/German/Italian/ Czech/Danish)	Protocol	RE (farmers) (Annex 3)	14	19 (DK/UK)
D3.2	Midterm report (English)	Report	PU	18	18/20
D3.3	Decision support tool for reducing environmental impacts	Software	PU (Annex 5)	32	38
D3.4	Article in professional journal on decision support tool for reducing environmental impacts	Article	PU (Annex 5)	32	38
D1.2	Automatic recording and feedback tool (handheld benchmarking system)	Software PigSurfer	P (Annex 3)	36	36
D3.5	Publication on the effect of the three housing/outdoor systems on environmental impacts across countries and climate zones	Report	PU (Annex 9a)	36	38
D3.6	Publication on the association between animal health and welfare and the environmental impacts in the three different housing/outdoor systems.	Publishable Report and Article in Farmers Journal	PU (Annex 11)	36	38
D3.7	Booklet for organic farmers/ advisors (Catalogue of improvement strategies), introduced to farmers and advisors during national courses	Booklet= handbook	PU (Annex 4)	36	38
D 3.8	Final report	Report	PU	36	38

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[3] Please indicate the nature of the deliverable. For example Report, Paper, Book, Protocol, Prototype, Website, Database, Demonstrator, Meeting, Workshop…

[4] Please indicate the dissemination level using one of the following codes: PU = Public; INT= Internal (Restricted to other project participants); RE = Restricted to a group specified by the consortium; CO = Confidential, only for members of the consortium.

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Additional comments (in case of major changes or deviation from the original list)

Table 4 Changes from original plan: M2.2 + M2.3: farm visits and D.2.1 (farm plans)

	farm visit 1		farm visit 2		
country	start	end	start	end	reasons for delay
AT	3.7.2012	20.8.2012	5.11.2012	7.12.2012	No delay
CH	13.07.2012	11.10.2012	26.11.2012	08.03.2013	Slight delay (visit 2): Some difficulties to find appointments for the farm visits.
CZ	16.8.2012	16.8.2012	18.11.12	18.11.12	No delay
DE	29.10.12	30.01.13	09.01.13	06.02.13	Slight delay: initially assigned and trained farm assessor had to be replaced due to severe illness
DK	03.12.12	24.01.13	19.04.13	17.5.2013	Delay: In DK it was decided, in addition to what was originally planned, to form an expert team discussing possible improvement strategies to discuss with the farmers in advance of the 2nd farm visit. This has caused the delay.
FR	04.9.2012	11.09.2012	15.12.2012	15.1.2013	Slight delay
IT	3.8.2012	12.10.2012	6.11.2012	13.12.2012	No delay
UK	2.11.2012	9.5.2013	May 2013	August 2013	Delay: difficulty in recruiting farms meeting the ProPIG size criterion due to contraction in the national organic pig production

The Decision Support Tool for Reducing Environmental Impacts was delayed due to unplanned staff issues of partner 3 - NU (extended sick leave of project scientist; WP leader S. Edwards retired onto reduced hours contract).

Cost neutral extension of project due to delay of farm visits and reduced work force of environmental group for 2 month (until 31.12.2014) was requested on 7.9.2014 and accepted by funding bodies.

Work package description and results:

WP 1	Definition of systems and development of assessment protocols of animal health, welfare and environmental impacts
Responsible partner: Partner no 3; NU, Gillian Butler	

Original description of work:

Identification and definition of the three housing/outdoor systems will be based on the amount of time spent during the year with access to paddocks and their type of flooring (soil / concrete). This will be done using data from the CorePIG survey, literature and expert knowledge. Two small groups of experts (formed by partners and external experts) will provide content and criterion validation of the issues of animal health and welfare and environmental impacts, respectively. Based on existing protocols (e.g. WQ$^{©,}$ (2009), Goossens et al. (2008)), **assessment tools** for animal health, welfare and environmental impact for use on farm will be created including training material for assessors. This includes the development of an automatic recording and feedback tool (handheld benchmarking system) and a Decision Support Tool for Reducing Environmental Impacts. In addition, a catalogue of possible improvement strategies will be collated in a working document for farm planning in WP 2.3, to be used by assessors as a 'back-up' for problems out of their range of experience. The experts will also be involved in ongoing training and support. Furthermore one group of experts will provide expertise on approaches to motivate improvement through farm specific planning strategies and formulate a common procedure to implement these on organic pig farms. A fourth group of experts will be responsible from an early stage onwards for the design of sampling protocols and data analysis.

Potential parameters for an on farm assessment protocol (to be developed in WP1 for use in WP2)

Environmental impacts will be assessed using both the methodological framework of Life Cycle Assessment (LCA) and calculations of nutrient balances at farm and outdoor area level. Pooled samples of feed and soil will be analysed on selected farms. To explain cause-effect mechanisms, additional information about nutrient flows within the farm will be used, such as manure management, feed management, pig housing and use of outdoor areas. On-farm data collection will include data on farm structure (e.g. buildings, manure management, hygiene procedures), resource input (energy, feed nutrients, bedding material, fertilizers, proportion of nutrients from on-farm grown feed, geographical origin and transport mode for feed ingredients produced off-farm) and farmer practices (fertilization, rotation of pig and crop areas, stocking rates) as well as outcomes such as net input/output of nutrients (N, P) at farm and outdoor area level and evaluation of vegetation cover in outdoor pasture. Furthermore, on selected farms utilization (in feed) and accumulation (in soil) of N, P, will be measured and soil fertility based on soil texture, organic matter (OM) and pH assessed.

Pig health and welfare will be assessed on farm during one day visits. A representative number of groups of each age category (pregnant sows, weaners, finishers) will be observed using quantitative and qualitative methods for scoring animal based parameters based on an adapted WQ$^{©}$ protocol (BCS, lesions, cleanliness). On each farm breed (conventional or local) and breeding (longevity) will be recorded and productivity (e.g. sold piglets/sow/year, mortality) and veterinary treatment data will be collected using existing records and additional basic data collected by the farmer during the project year if necessary. A simple MS Excel® tool to calculate rations based on feed ingredients will be used to assess nutritional inputs for evaluation of feed management.

Farmers: At the beginning and the end of the monitoring period, a brief qualitative questionnaire will be used to explore expectations, satisfaction, opinions and goals of farmers and their families. This will allow integration of farm specific goals into the improvement process and give a qualitative evaluation of the project from the farmers' point of view. Some **basic economic data** will be collected to allow to evaluate competitiveness of the farms in the study and to

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describe the economic consequences of improvements. This will be based on performance data (e.g. number and weight of pigs sold/sow/year, resource inputs detailed previously) and national prices/figures. Fixed costs will be estimated from farm structure data, collected as detailed previously.

Report on results obtained and changes to the original plan/WP aims:
A- results obtained:
The working definition for the 3 systems was :
- **Outdoor Pigs** live permanently outdoors with shelter for sleeping but unrestricted access to the soil (shelter could be a temporary hut or permanent building). Paddocks are integrated in crop rotation and not just a sacrifice area for permanent pig use.
- **Indoor - pigs** live in buildings with access to an outdoor run or a small sacrifice soil area for permanent pig use - not integrated into crop rotation.
- **Partly outdoor - pigs** spend part of the year or production cycle in each system type (at least one production stage is fully housed while the rest is outdoor. A production stage could be dry sows, lactating sows, e.g. group suckling, weaned piglets or finishing pigs. The combination of indoor and outdoor production might occur within the same farm or in linked farms if piglets are produced on one farm but finished on another or seasonal housing of animals ('Swedish system').

Assessment tools (Animal/Environment/Farmer) Documentation used on farms are attached. This includes a qualitative interview with the farmer (Annex 6), assessment of animal health and welfare and vegetation cover in paddocks (Annex 1). Data necessary for LCA were integrated in PigSurfer and used in an excel calculation sheet. Inputs were collected for all farms on animal performance, housing, manure management, feed composition and origin, which were used to predict greenhouse gas emissions, acidification, eutrophication potential and land use - expressed per ha as well as per kg live weight pig at slaughter.

The automatic recording and feedback tool (PigSurfer) was ready for use on a tablet computer for the training session in France and was widely used throughout the project to record inputs and generate farm benchmarking reports (handbook as Annex 3).

Standard operational procedures (SOPs) were developed for collection of feed and soil samples as well as how to facilitate the discussion during the second farm visit on areas to improve and measures to achieve this (Annex 2).

Economic data were obtained from each partner country on feed costs and the prices obtained at sale for organic pigs. These were used to calculate the margin over feeds costs for different recorded scenarios of good and poor farm performance, value of pigs sold and feed costs. Under all 3 production systems the most efficient farms were able to generate a profit, even with the challenging circumstances of high feed costs and low pig sales, whilst the least efficient made a considerable loss, alleviated only by both low feed costs and high pig prices (Annex 7).

Soil samples were taken according to the standard protocol on a sample of 23 farms to give a total of 45 sets of matched paddock areas with High, Low or No pig influence. Samples were analysed for extractable and total Phosphorus, and for mineral and total Nitrogen. On most farms/paddocks the presence of pigs had a high influence on extractable and total P, and mineral and total N. However, nutrient concentration varied strongly between countries and farms, and sometimes even between paddocks on the same farm (Annex 9c).

Feed sample data collected on the composition of diets on each farm were used to estimate their nutrient content using the Evapig database. The estimated energy and essential amino acid content were then compared to calculated pig requirement for the relevant production stage. Whilst many farms operated appropriate feeding, some showed poor feed management, with a common diet across different production stages giving inadequate amino acid supply despite environmentally damaging oversupply of crude protein (Annex 8).

B- comments on deviations from the original plan:
The omission of Sweden from this call between drafting and implementing ProPIG resulted in the loss of expertise covering the environmental impact within the consortium. This made it challenging to deliver some of our milestones, although the 2 months extension to the project has permitted these to be achieved.

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WP 2	On-farm assessment and application of improvement strategies of animal health, welfare and environmental impacts

Responsible partner: Partner No 6, DJF-AU, Tine Rousing

Original description of work:

A prospective cohort observational study will compare the health and welfare status and environmental impacts of the three husbandry types. Each cohort will consist of approximately 25 farms distributed across eight European countries and various climate zones. This will include in total 75 farms: Austria (15), Czech Republic (1), Denmark (12), France (4), Germany (15), Italy (8), Switzerland (8), and UK (12). Outcome parameters will be selected measures of health, welfare and environmental impacts defined in WP1 and their economic consequences. The consortia will use their existing contacts and additional farmers will be invited to participate in the project using advertisements through organic associations' bodies and in pig farming journals.

Farm visits will be carried out by trained assessors who will start recording data after reaching a set level of inter-observer reliability. During farm visits national advisors will assist knowledge transfer to and from producers. There will be three visits to participating farms:

- visit 1: Assessment and data collection of environmental impacts and animal health and welfare
- visit 2: Feedback of summarised information from visit 1. The information will be presented as 'benchmarking' (ranking of national data). Based on this a 'plan' will be written with the farmer, which includes the goals set by the farmer for improvement of animal health, welfare, nutrition and management of outdoor areas and manure utilization, and intended improvement strategies. This will include the use of HACCPs from CorePIG, if relevant. The researcher will act as a facilitator to support the farmer on his/her decisions and provide strategies for improvement of animal health, welfare, nutrition and management of outdoor areas and manure utilization. If requested by the farmer, the advisor and/or consulting veterinarian for the farm will be encouraged to participate.
- between farm visits, farmers will be supported during the implementation process by phone and email.
- visit 3: Takes place one year after visit 1. It includes re-assessment of the farm situation regarding animal health and welfare and environmental impacts using the same parameters as before. Also economic key data will be collected during this visit. Furthermore a new plan will be made together with the farmer in order to allow for a continuation of the process. At this stage it is possible to benchmark farms of all countries within and across husbandry systems.

Report on results obtained and changes to the original plan/WP aims:
A- results obtained:

The planned 3 cohort study – one for each of the 3 different housing systems defined in WP1 'indoor', 'partly outdoor' and 'outdoor' - is based on a total of 74 farms from the different project member countries. Detailed information on the distribution of housing systems between the different countries is given in Table 5.

Table 5 Numbers of farms per country. AT = Austria, CH = Switzerland, DE = Germany, IT = Italy, CZ = Czech Republic, DK = Denmark, FR = France, UK = United Kingdom

system	AT	CH	DE	IT	CZ	DK	FR	UK	total
a) indoor	12	7	13	2	0	0	0	0	34
b) partly	3	2	3	3	1	11	4	2	29
c) outdoor	1	0	0	4	0	0	0	6	11
total	16	9	16	9	1	11	4	8	74

Training of observers: in total four training sessions were held to achieve common standards of assessment across all partners and countries.

At **first farm visits** data for quantification of animal health, welfare and environmental impact were collected. These data were based on farmers' interviews on management and production and direct observations of the animals and husbandry, including quality of grass cover in paddocks. Furthermore, feed samples were taken for all farms (except DK) and soil samples for selected farms.

Data of the first farm visits were entered in a software (PigSurfer) - and farm specific reports on animal health, welfare and production were created (Annex 3). Reports including the individual farm results benchmarked anonymously with the results of the other farms from the same country were, at the **2nd farm visit,** presented to and discussed with the individual farmers. The farmer, facilitated by the project partners defined goals and measures for improvement of selected issues. Where relevant, parts of HACCP-programs derived from the project CorePIG were utilised. All information collected across member countries together with project partner input on improvement strategies formed the basis of the 'Catalogue of improvement strategies' (COIS) for animal health and welfare in organic pig production across Europe.

At the **final 3rd farm visit** a follow-up quantification of animal health, welfare was carried out. In Table 6 an overview of implementation and success as assessed by farmers' self-evaluation is presented. Areas most commonly addressed by farmers were fertility, nutrition, health and lesions. The median number of aims per farm was 2 (range 1 to 4). Out of 69 farms, 26 % (n = 18) set 1 aim, 36 % (25) set 2 aims, 30 % (21) set 3 aims, and 7 % (5) set 4 aims for their farm. Out of 59 farms where farmers had subjectively judged the achievement of aims [no DK], 34 % (20) judged all aims as achieved, 8 % (5) judged none and the remainder (58 %, n = 34) judged some but not all as achieved. Achievement rates were similar to implementation rates (e.g. both high regarding lesions; both low regarding respiratory problems).

Table 6 Numbers and proportions of improvement strategies implemented and goals achieved (self-evaluation by farmer)

aim category	Measures not implemented	Measures partly implemented	Measures fully implemented	Measures total	Measures (%) partly/fully implemented	Aims (%) partly/fully achieved
diarrhoea	4	2	9	15	73,3	**75,0**
fertility	18	15	30	63	71,4	**82,8**
health	5	7	18	30	83,3	**75,0**
lesions	5	7	19	31	83,9	**94,7**
management	3	4	13	20	85,0	**86,7**
nutrition	9	12	14	35	74,3	**89,5**
parasites	2	1	7	10	80,0	**71,4**
respiratory	11	4	7	22	50,0	**58,3**
total	57	52	117	226	74,8	**81,6**

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B- comments on deviations from the original plan (Table 4**):**

According to the original work package description it was planned to include in total 75 farms, assuming, they were all breeding to finishing.

Due to recruitment difficulties in UK (due to contraction in the national organic pig production) 9 farms were visited (instead of 12), of which one dropped out for the final visit. In other countries some minor deviations in number of farms occurred due to:

- either difficulty recruiting a sufficient number of farms within the defined categories of housing systems (DK: 11 instead of 12 farms),
- or difficulties in recruiting a sufficient number of breeding to finishing farms. Thus more farms were included in order to be able to cover all animal groups: in AT/DE (16 instead of 15 farms) IT/CH (9 instead of 8 farms).

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WP 3	**Analysis, evaluation and dissemination**

Responsible partner: Partner No 7, FLI, Sabine Dippel

Original description of work:

Analysis of associations between housing and management systems regarding health and welfare and environmental impact will consist of two stages. Stage 1 is based on th*e* data collected at visit one, which represent data of a cross sectional survey. The farming types will be compared regarding health and welfare and environmental impact using nonparametric statistics. Furthermore, data will be summarised with factor analysis and multiple correspondence analysis. These analyses allow the formation of farm groups based on characteristic traits, which can then be used for comparisons of e.g. disease prevalence or environmental impact.

In stage 2, the data from farm visits 1 and 3 together with the records collected over one year will form the basis for a more detailed analysis of effect of farming type on health and welfare and productivity. The appropriate statistical methods will be chosen depending on the hypotheses and exact nature of data (type of data, distribution etc.), but will probably include multivariate regression and generalised mixed models.

The improvement strategies applied during one year between farm visits 2 and 3 will be evaluated by analysing number of implemented measures and goals achieved and by comparing the findings of visits 1 and 3. The effect of improvement strategies will be assessed using nonparametric or parametric statistics as appropriate. Parameters will be identified in advance, where it is reasonable to expect measurable effects even within this short period of time (one year).

Dissemination activities will include articles on all relevant findings in scientific and professional/industry journals. Booklets and training material for organic pig farmers and advisers will be developed based on results and experiences from the study, which will be introduced during national courses. The Automatic Recording and Feedback Tool (handheld benchmarking system) and the Decision Support Tool for Reducing Environmental Impacts will also be introduced during national courses and be made publicly available via a project webpage.

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Report on results obtained and changes to the original plan/WP aims:

Data regarding animal health and welfare (AHW) and environmental impact (ENV) as well as farm aims and improvement measures have been collected on 74 farms (Table 5). During the initial farm selection, farms with incomplete production chains (e.g. finishing farms) were paired with farms from whom they bought / to whom they sold pigs. These thus complete production chains (PC) were the units of observation for all ENV calculations.

Prevalences of AHW problems were compared at two levels using nonparametric tests: a) current location during assessment (indoor or outdoor), and b) system of the farm (indoor, partly outdoor, outdoor = IN, POUT, OUT, respectively). ENV analysis consisted of Life Cycle Assessments (LCA) regarding global warming potential (GWP), acidification (AP) and eutrophication (EP) potentials. Additionally, N and P balances were calculated for each PC. ENV results were compared between PC system (IN, POUT, OUT; nonparametric tests) and PC were clustered based on their LCA results. Furthermore, AHW results were compared between LCA clusters (correlations, nonparametric tests). Analyses are described in detail in annexes 9 to 12.

Results AHW (details in annex 10): In general, prevalence of AHW problems was low across farms. Seven parameters differed significantly for at least one production stage in animals assessed indoor or outdoor, and between farm systems. Two additional parameters differed each in animals assessed indoor or outdoor, and between farm systems, respectively.

Results ENV (details in annex 9): The largest proportion of environmental impact originated from feed, followed by direct emissions of animals. Most emissions were generated in the fattening stage. GWP did not differ between PC systems, yet AP was significantly lower in POUT than in IN, and EP lower in POUT than in OUT. LCA cluster analysis resulted in 3 clusters of higher, medium and lower environmental impact, plus two clusters with two PC only. Numbers of IN, POUT and OUT PC did not differ between clusters.

No significant association were found between AHW and environmental impact (annex 11).

For all aim categories but respiratory problems, farmer implemented >70 % of measures and reached >70 % of aims (annex12). The effect of measure implementation on outcome parameters is currently being analysed.

Dissemination (see ch. 4 for details):

Several leaflets with a project description were distributed to stakeholders. ProPIG partners presented ProPIG at 15 stakeholder workshops, as well as in 5 posters and 1 presentation at international conferences.

A booklet for farmers with comprehensive knowledge on AHW problems and improvement strategies across all housing systems is currently in print as a robust ring binder (in English, will be translated into German and French). The Decision Support Tool for Reducing Environmental Impacts is currently being finished. The handheld benchmarking system (PigSurfer) is available from the consortium and its publication on the internet is being prepared.

B- comments on deviations from the original plan:

Analysis of AHW data was less complex than originally planned because of the relatively low average prevalence of problems on the farms and thus lack of variation in the data (annex 10). Analysis of improvement strategy effects took longer than expected due to the individuality of farm measures. The Decision Support Tool for Reducing Environmental Impacts was delayed due to unplanned staff issues of partner 3 - NU (extended sick leave of project scientist; WP leader S. Edwards retired onto reduced hours contract).

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4. Publications and dissemination activities

4.1 List extracted from Organic Eprints

Contributions related to CoreOrganic II events:

1. http://orgprints.org/20408/

   {Projekt} ProPIG: Farm specific strategies to reduce environmental impact by improving health, welfare and nutrition of organic pigs. Laufzeit: 2011 - 2014. Leiter/in: Leeb, Dr. Christine, University of Natural Resources and Life Sciences (BOKU). Sat Apr 20 14:02:48 2013 CEST**.**

2. http://orgprints.org/20095/

   Leeb, C. (2011) ProPIG. CORE Organic II Research Seminar, Paris, France, 29 November 2011. Sat Apr 20 14:02:48 2013 CEST.

3. http://orgprints.org/ ....

   Leeb, C. (2013) ProPIG. 2nd CORE Organic II Research Seminar, Amsterdam, Netherlands, 15 May November 2013. Submitted (under review)

4. http://orgprints.org/27989/

   Leeb, Christine (2014) Presentation at Core Organic II Research Seminar - Farm specific strategies to reduce environmental impact by improving health, welfare and nutrition of organic pigs. Stockholm, 1st October 2014.

Peer reviewed contribution at scientific conferences:

5. http://orgprints.org/22582/

   Rudolph, Gwendolyn; Bochicchio, Davide; Butler, Gillian; Dippel , Sabine; Dourmad, Jean Yves; Edwards , Sandra; Früh, Barbara; Illmann, Gudrun; Meier, Matthias; Prunier, Armelle; Rousing, Tine; Salomon, Eva; Silerova, Jitka; Sorensen, J.T.; Urban, Jiri; Vertes, Francois; Winckler, Christoph und Leeb, Christine (2012) ProPIG - Organic pig health, welfare and environmental impact across Europe. Poster at: Minding Animals, Utrecht, The Netherlands, 4-6 July 2012.: Sun Apr 28 23:26:25 2013 CEST.

6. http://orgprints.org/22616/

   Rudolph, Gwendolyn; Bochicchio, Davide; Butler, Gillian; Dippel, Sabine; Dourmad, Jean Yves; Edwards, Sandra; Früh, Barbara; Illmann, Gudrun; Meier, Matthias; Prunier, Armelle; Rousing, Tine; Silerova, Jitka; Salomon, Eva; Sorensen, J.T.; Urban, Jiri; Vertes, Francois; Winckler, Christoph und Leeb, Christine (2012) ProPIG – Betriebsspezifische Strategien zur Reduktion der Umweltauswirkung von Bioschweine Betrieben durch Verbesserung von Tiergesundheit, Wohlergehen und Ernährung von Bioschweinen. [Farm specific strategies to reduce environmental impact by improving health, welfare and nutrition of organic pigs.] Poster at: Tagung Forschung und Lehre zur Ökologischen Landwirtschaft an der Universität für Bodenkultur, Wien, Österreich, 18.10.2012. Sat May 11 19:16:09 2013 CEST.

7. http://orgprints.org/25627/

   Rudolph, Gwendolyn; Bochicchio, Davide; Brandhofer, Roland; Berner, Alfred; Butler, Gillian; Dippel, Sabine; Dourmad, Jean Yves; Edwards, Sandra; Früh, Barbara; Holinger, Mirjam; Holmes, Diane; Illmann, Gudrun; Knop, Denise; Meier, Matthias; Prunier, Armelle; Rousing, Tine; Salomon, E.; Silerova, Jitka; Sorensen, J.T.; Urban, Jiri; Vertes, Francois; Winckler, Christoph und Leeb, Christine (2014) 'ProPIG' Challenges and opportunities for on farm pig researchers: How to collect sound scientific data on animal health, welfare, nutrition and environmental impact AND act as a facilitator to improve these aspects at the same time? Poster at: The 11th European IFSA Symposium, Berlin, 1.4.-4.4.2014. Sun Nov 23 19:42:38 2014 CET

8. http://orgprints.org/26928/

Dippel, Sabine; Bochicchio, Davide; Holinger, Mirjam; Holmes, Diane; Knop, Denise; Prunier, Armelle; Rudolph, Gwendolyn; Silerova, Jitka und Leeb, Christine (2014) Trough or bowl? Observers need training for assessing resource as well as clinical parameters. In: Mounier, Luc und Veissier, Isabelle (Hrsg.) *Proceedings of the 6th International Conference on the Assessment of Animal Welfare at Farm and Group Level*, Wageningen Academic Publishers, Wageningen, NL, S. 182. Sun Nov 23 19:42:38 2014 CET.

9. http://orgprints.org/26922/

Leeb, Christine; Bochicchio, Davide; Butler, Gillian; Edwards, Sandra; Früh, Barbara; Illmann, Gudrun; Prunier, Armelle; Rousing, Tine; Rudolph, Gwendolyn und Dippel, Sabine (2014) PigSurfer – SURveillance, FEedback & Reporting within ProPIG for communication with 75 pig farmers. In: *Proceedings of the 6th International Conference on the Assessment of Animal Welfare at Farm and Group level.* Sun Nov 23 19:42:38 2014 CET

10. http://orgprints.org/26945/

Prunier, Armelle; Rudolph, Gwendolyn; Bochicchio, Davide; Butler, Gillian; Dippel, Sabine und Leeb, Christine (2014) Nutritional characteristics of the diets in organic pig production. In: *Book of Abstracts of the 65th Annual Meeting of the European Federation of Animal Science*, Wageningen Academic Publishers, Wageningen, NL, S. 249. Sun Nov 23 19:42:38 2014 CET.

Farmers and advisor meetings

11. http://orgprints.org/24279/

{Projekt} *ProPIG - A research project to help organic pig production - leaflet for farmers.* Laufzeit: 2011 - 2014. Leiter/in: Leeb, Dr. Christine, CoreOrganic2. Sun Nov 23 19:42:38 2014 CET.

12. http://orgprints.org/20076/

Rousing, T. und Sørensen, J.T. (2011) PROPIG. Presentation at: Statusmøde Organic RDD og CORE Organic II, Horsens, Denmark, 16 November 2011. [Eingereicht] Sat Apr 20 14:02:48 2013 CEST.

13. http://orgprints.org/24287/

Rudolph, Gwendolyn und Leeb, Christine (2012) ProPIG - Informationen über das Projekt für LandwirtInnen- BioAustria Bauerntage. [ProPIG - Project Information for Farmers - BioAustria Bauerntage.] . Sun Nov 23 19:42:38 2014 CET.

14. http://orgprints.org/23688/

Leeb, Christine (2013) Assessment of animal welfare and environmental impact. Vortrag at: Scientific Workshop on Organic Pig Production, Hovborg, Denmark, 12.-13.6.2013. Sun Nov 23 19:42:38 2014 CET.

15. http://orgprints.org/24885/

Bonde, Marianne; Kongsted, Anne Grete; Mejer, Helena; Rousing, Tine und Serup, Tove (2013) Fremtidens udfordringer i svineproduktionen. *Økologisk Nyhedsbrev*, Dezember 2013, 10, S. 12-13. Sun Nov 23 19:42:38 2014 CET.

16. http://orgprints.org/25224/

Meier, Matthias (2013) ProPig: Umweltauswirkungen der Bioschweinehaltung. Vortrag at: Bioschweinetagung, FiBL Frick, Schweiz, 12. Dezember 2013.

17. http://orgprints.org/25570/

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> Butler, Gillian (2014) – Output from ProPIG (and LowInputBreeds) that might be useful for organic pig and poultry producers. Presentation in UK at the 9th Organic Research Centre's producers' conference, Solihull, Birmingham, November 2014

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> i. Illmann, G. and Melisova, M. (2014): Presentation an Czech farmers meeting. Submitted to Orgeprints- under review

Master- and PhD Theses

- **Ines Taschl** (2014): Stickstoff- und Phosphorbilanzen europäischer, biologisch wirtschaftender Schweinemast- und Zuchtbetriebe unter unterschiedlichen Haltungsbedingungen. Masterthesis. University of Natural Resources and Life Sciences (BOKU), Vienna, Austria.
- **Robert Brandhofer:** Umweltwirkungen biologischer Schweinehaltung: Vergleich zweier Haltungssysteme auf Basis des Treibhausgas-Potenzials sowie einer Stickstoff- und Phosphorbilanz. Masterthesis. University of Natural Resources and Life Sciences (BOKU), Vienna, Austria. Unpublished
- **Katharina Fohringer:** Risikofaktorenanalyse von Hautverletzungen bei Bioschweinen. Masterthesis. University of Natural Resources and Life Sciences (BOKU), Vienna, Austria. Unpublished
- **Gwendolyn Rudolph:** Effect of husbandry system on animal health, welfare and environmental impact of organic pigs in selected European countries. PhD thesis. University of Natural Resources and Life Sciences (BOKU), Vienna, Austria. Unpublished

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4.2 Additional dissemination activities

No	Planned / actual date	(No.) and title	Type:	Partners involved: (partner acronyms)	Type of users addressed	Coun-tries
A	01.03.2012	Introduction to ProPig	Presentation at farmer meeting at FiBL – Bioschweinetagung 2012	FiBL	Farmer, Advisor	CH
B	07.03.2013	Introduction to ProPig	Presentation at farmer meeting at FiBL – Bioschweinetagung 2013	FiBL	Farmer, Advisor	CH
C	May 2012	Na pomoc ekologickému chovu prasat (Help for organic farming of pigs).	Zemědělec č. 33	IAS, Bio-I	Farmers	CZ
D	August 2012	Organic free Farrowing systems	Visit Research farm Wels/Thalheim; introduction Welser Bucht/WelCon, group farrowing/suckling	BOKU, IAS, FIBL; FLI (BAT), CRA-SUI	Researchers	AT; DE; CZ; CH; IT;
E	October 2012	Vyzkumní projekt ProPIG. Scientific project ProPIG :	Bioměsíčník č.	IAS, Bio-I	Farmers	CZ
F	26.6. 2012	Presentation	Meeting of the organization of organic farming	IAS, Bio-I	Farmers	CZ
G	10.7. 2012	Presentation	Project Presentation	IAS, Bio-I	Ministry of Agriculture	CZ
H	2012	websites	www.bioinstitut.cz, www.agroweb.cz, www.ctpez.cz.	IAS, Bio-I	Farmers, advisors, organic farming	CZ
I	September 2014	Farrowing systems Excursion	Visit of CZ to Newcastle 'PigSafe pen'	IAS, Univ. Newcastle	Researchers, Company	CZ, UK
J	25.-26.11. 2014	Czech – Austrian organic pig farming days	Excursion, 5 pig farmers, 6 researchers, 1 company	IAS, BOKU	Farmers, advisors, researchers	CZ, AT

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4.3 Further possible actions for dissemination

Especially the '**Handbook for Farmers**' is an outcome of this project, which is specifically addressing farmers. The format is a ring-binder, with pages suitable for use in the pig barn as well as outdoors. It is translated already into French, German and Czech, however, other languages (e.g. Italian, Spanish, Rumanian) should be considered.

It will be disseminated via common routes such as FIBL, organic farmer meetings (e.g. BioAustria Bauerntage); however it could also be – after additional printing- be disseminated across other countries.

Also **PigSurfer** could be translated into other languages (currently available in English, German, and Italian) – however, this should be done according to specific interest from countries. PigSurfer offers also potential to be used for other species or applications (e.g. certification).

Translation of the **environmental decision support tool** is also recommended. So far it is available in English, but its further dissemination would benefit from translation into other languages.

Another possibility to spread outcomes of ProPIG after project end would be national farmer meetings (organised/funded by national bodies) where jointly with similar CoreOrganic II projects (e.g. ICOPP; SafeOrganic, Healthy Hens) results and conclusions could be presented and further discussed.

Furthermore contacts between farmers, advisors and researchers, which were established within ProPIG should be supported to carry on, even when the project is finished- one example is a potential excursion of Austrian organic farmers and advisors to the Czech ProPIG farm.

4.4 Specific questions regarding dissemination and publications

- Project website will be updated with final outcomes of ProPIG

List the categories of end-users/main users of the research results and how they have been addressed/will be addressed by dissemination activities

- **Farmers:** At the beginning of this project many activities in all countries were carried out to introduce ProPIG and to recruit farms. All participating farmers were visited several times, and farm specific reports showing farm specific outcomes (including results from feed and soil samples) with benchmarking were delivered, as well as continuous support provided. With 'Pigsurfer' (Automated recording and Feedback Tool) and the 'Handbook for Farmers' useful instruments for all (organic) pig farmers were developed.

- **Advisors/Vets:**
  This group was introduced to ProPIG by leaflets and meetings. The main deliverables 'Handbook for Farmers' and the 'Environmental Decision support Tool' are useful tools for advisors to investigate animal health and welfare problems as well as to give targeted advice for improvement of environmental impact. Furthermore PigSurfer offers a great opportunity to be integrated into professional health and welfare planning approaches, as conducted by existing animal health services, as it enables objective and time efficient data collection as well as tools for communication with farmers (benchmarking/farm plan).

- **Others:** Furthermore the process of 'Health and welfare planning' (Vaarst, 2010) is introduced by this project to organic pig farmers, advisors, vets and researchers across Europe. Knowledge on calculation of rations (e.g. using 'EvaPig'), interpretation of soil analysis as well as results from LCA (GHGE/EP/AP) was gained by those groups.

Summary of National training courses on ProPIG for farmers and advisors (see 4.1 and 4.2):

	Overview of ProPIG	Environmental impact/ EDST	Animal health & welfare/ Handbook
12, 13, 15, 18, A, B, F	x		
14, 16, 17		x	
19, 20		x	x
J	x		x

Impact of the project in relation to main beneficiaries of the project results
- **Farmers**

All participating farmers across Europe were directly addressed and the project had a direct impact on these, as not only data collection happened, but improvements were discussed and agreed. The implementation and effectiveness of these measures will be monitored during the final visit. Furthermore the improvement measures suggested by farmers as well as those of experts, which are collected into the 'Catalogue of improvement strategies', can potentially act as a very comprehensive tool to improve animal health and welfare.

Also the results of the project can be used, when deciding on new systems, as data will be available regarding economy, health and welfare as well as environmental impact.

- **Advisors/veterinarians**

The results as well as the gained tools (Pigsurfer, Handbook for farmers, Environmental decision support tool) can provide not only data regarding advisory work but also very practical tools for individual situations.

- **Scientific community/Decision makers**

The project provides the first comprehensive dataset on measures of animal health and welfare and environmental impact of organic pig farms throughout Europe. This provides benchmarks for future scientific studies and data which can be used to underpin future policy decisions in these subject areas. The Pigsurfer tool can be utilised to facilitate data collection in future scientific studies, and has flexibility to allow modification for use with other systems or species.

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5. **Added value of the transnational cooperation in relation to the subject**

Data collection across countries

- Data collection across countries using one method has the enormous advantage to create a large data set, which is not possible within one country only.
- The evaluation of environmental impacts of different housing systems in Europe can only be carried out in a transnational European project. Besides the distribution of climatic factors, certain types of housing systems are more prevalent in some countries than in others, and the type of crop products used and their geographical origin (and transport distance) varies

Common learning process and exchange of methods:

The transnational knowledge transfer between researchers and farmers in the project facilitated the development of the organic pig production at both the national and transnational level:

- o Health and welfare assessment (e.g. CZ behavioural expertise but little experience in on-farm data collection), on-farm assessors were trained in all countries, so a group of experts is now available in all ProPIG countries
- o LCA (esp. FR, AT, CH, UK) exchange of methods for calculation across countries
- o Health and welfare planning (experiences from Coreorganic ANIPLAN (AT) are shared with other partners; transfer from Dairy health planning into pig farming

Research cooperation established:

Knowledge and network from CorePIg and ANIPLAN was expanded to a new country (Czech Republic) who provided new perspectives and knowledge.

- Austrian PhD student research periods in Germany with S. Dippel
- Austrian Master student stayed in France with JY Dourmad/A. Prunier (short scientific travel stipend 'KUWI') to learn LCA
- Swiss Researcher (M. Holinger) carried out on-farm assessments in France
- Soil experts E. Salomon (Sweden) close contact to consortium, especially IT partner D. Bochicchio
- Knowledge transfer with CoreOrganic ICOPP, ImproveP, Healthy Hens

Experience and learning from different situations

The accumulated knowledge about interactions between housing systems, farm management, climatic factors, animal health/welfare and environmental impact enables identification of the most suitable alternatives of organic pig farming across the varied climatic and societal conditions, thus promoting sustainable and economically competitive development of this sector of animal husbandry

- Farm visits during workshops allow in depth experience of organic pig farms in other countries
- Several opportunities to exchange farmers/students/researchers:
  - excursion of German/Austrian organic pig farmers to UK 2010 following contacts from CorePIG); Excursion from Czech pig farmer researchers to Austrian (organic) pig farms in 2014, planned return visit for 2015

Efficient use of resources

- Software programme would be too expensive for one partner alone
- Layout and printing of a Ring-binder also benefits from joint effort

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ANNEX 1: CHANGES IN WORK PLAN AND PROBLEMS ENCOUNTERED

Changes in consortium and work plan

Consortium
The consortium consists of same partners as in the proposal, with only few minor updates:
DE/IT/DK: no changes
AT: DI Gwendolyn Rudolph was employed as PhD student to carry out the project in Austria
CH: Mirjam Holinger was employed to carry out farm visits
UK: Diane Holmes employed to carry out farm visits
CZ: Gudrun Illmann acts as Czech Project leader, Jitka Silerova carried out farm visits, Misa Melisova contributed to 'Handbook for farmers'
FR: due to restricted availability of funding H. van der Werf was not involved in ProPIG

Workshop 4 and 5 were combined in order to have sufficient resources to allow participation of all on-farm observers on all training sessions.

WP 1
In WP 1 no deviations from original plan; expert groups consist mainly of partners, as little funding for external experts available. Eva Salomon, originally proposed as a partner but obliged to withdraw, participated as a self-funded external expert.

WP 2
According to the original work package description it was planned to include in total 75 farms (now 74), assuming, they were all breeding to finishing. Due to recruitment difficulties in UK (due to contraction in the national organic pig production) only 8 farms were assessed (instead of 12). In other countries some minor deviations in number of farms have appeared: This was due to difficulty in recruiting a sufficient number of:
- farms within the defined categories of housing systems (DK: 11 instead of 12 farms)
- breeding to finishing farms. In this case more farms were included in order to be able to cover all age groups: in AT/DE (16 instead of 15 farms) IT/CH (9 instead of 8 farms).

WP 3
After discussions among the consortium and with the Core Organic office it was decided not to create a separate project website but instead use the common CoreOrganic2 site to present ProPIG to stakeholders. This website was set up three months later than intended due to technical difficulties on the host side.

Problems encountered, delays and corrective actions planned or taken, if any:
- Delay of start of farm visits in DE due to sick leave, therefore it was necessary to train another observer; however, farm visits were carried out only with one month delay.
- Insufficient number of farms in UK: Recruitment was stopped, as data were needed to start analysis across all countries.
- Request for extension of project
- Delay in creation of environmental decision support tool

ANNEX 2: COST OVERVIEW AND DEVIATIONS FROM BUDGET

Project budget and costs in € (if in National currencies, please indicate):

Partner no.	1 BOKU	2 FIBL	3 NU	4 CRA – SUI	5 INRA	6 DJF-AU	7 FLI	8 IAS	9 Bio-I
TOTAL BUDGET	99649.0	53083.3	118863.0	90000.0	25000.0	199613.0	159160.8	24334.0	5000.0
Spent at Mid term	61672.0	30136.1	42255.0	33559.4	8640.0	68189.0	82503.7	12000.0	1200.0
Spent in 2nd period	37977.0	28414.3	84622.0	56398.8			71316.8	15134	1000
TOTAL SPENT	99649.0	58550.5	126877.0	89959.2			153820.	27134	2200
DEVIATION	0	+5467.2	+8014.0	-41.8			+5340.3	2800	-2800

Person months (PM) spent on the project:

Partner no.	1 BOKU	2 FIBL	3 NU	4 CRA – SUI	5 INRA	6 DJF-AU	7 FLI	8 IAS	9 Bio-I
TOTAL PM budgeted	24	3.75	16.3	31	4.25	15.5	14.75	6	1.6
Spent at Mid term	17	3	6.3	12	4.25	9.75	6.5	4.8	1
PM spent in 2nd period	7	4.9	10	21			8.25	4.0	0.1
TOTAL PM SPENT	24	7.9	16.3	33			14.75	8.8	1.1
DEVIATION	0	+4.15	0	+2			0	+2.8	-0.5

Reasons for major deviations in spending compared to original budget:

Partner 2: FIBL: In Switzerland the derivation on person months is due to some extra work in relation to the Handbook, the qualitative questionnaire and the soil result descriptions.

Partner 7 FLI: The total budget of 151,948.40 was increased by 4,869.10 EUR for salaries and 2,343.30 EUR for Handbook in German. Leftover budget consists of booklet money and special retained travel funds. Total PM budgeted were increased from 14 to 14.75 PM.

Partner 5 and 6: data not available yet, will be provided for final report submission to CoreOrganic on 31.March 2015.

Partner 8 and 9: CZ: IAS got a contract from the Ministry of Agriculture for IAS and the Bioinstitut together. IAS was more involved in ProPIG and got a part of the money from the Bioinstitut. The money from the Bioinstitut was mainly used for paying the Handbook. The person months were higher as planned, but based on the lower salary in the Czech Republic it was possible to cover these.

ANNEX 3: RECOMMENDATIONS TO THE CORE ORGANIC CONSORTIUM IN RELATION TO LAUNCHING AND MONITORING OF FUTURE TRANSNATIONALLY FUNDED RESEARCH PROJECTS.

- Coordination of joint starting and end point of project with clear communication of one joint date to coordinator/all partners, when to deliver reports
- Clear communication on one joint final report – no national additions to simplify reporting
- Recognition of specific administrative tasks and travel requirements for coordinators and WP leaders
- Very different amounts of funding are sometimes challenging regarding distribution of work across countries- e.g. one farm in CZ compared to 16 farms in Austria/Germany.
- Doctoral college
- Other template for final report
- Use of joint resources and professional support for dissemination to stakeholders (also beyond project end)-
- Specific efforts/structures needed for including advisory bodies in projects – language problems/resources available/no structures_responsibilities for trans/national projects

Further documents as attachment with main contact person(s):

Annex 1: Farm Assessment protocol including Animal based & resource definitions, vegetation cover sheet, PigSurfer Dictionary (C. Leeb)

Annex 2: Standard Operating Procedure_SOP- soil/feeding/improvement (C. Leeb)

Annex 3: Pigsurfer: Handbook and example Farm report (S. Dippel)

Annex 4: Handbook for Farmers (B. Früh)

Annex 5: Description of Environmental Decision Support Tool_EDST (S. Edwards/G. Butler)

Annex 6: Qualitative Interview – Results and Questionaires (M. Holinger)

Annex 7: Description of Financial impact (G. Butler)

Annex 8: Feeding strategies (A. Prunier)

Annex 9: manuscript 'Effect of husbandry system on environment al impact across countries and climate zones'
  - o **9a**: LCA including GHGE/AP/EP (G. Rudolph)
  - o **9b:** N/P balances (G. Butler)
  - o **9c:** Soil results and explanation for farmers (D. Hegglin)

Annex 10: manuscript 'Effect of husbandry system on health, welfare and productivity of organic European pig farms' (S. Dippel)

Annex 11: manuscript 'Association between health, welfare and environmental impact of organic pigs in three European husbandry systems' (G. Rudolph)

Annex 12: manuscript 'Improvement strategies for health, welfare and environmental impact on organic pig farms across Europe (C. Leeb/T. Rousing)

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