



## Midterm Status Report 2002 and Application for Continuation in 2003

For research projects financed by grants from  
The Directorate for Food, Fisheries and Agro Business  
under the Danish Ministry of Food, Agriculture and Fisheries

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### 1. Research program

Research in organic farming 2000-2005 (DARCOF II)

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### 2. Project title and number

II.9 Resource use, environmental impact and economy in organic pig production systems

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### 3. Head of project

John E. Hermansen

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### 4. Participating institutes

Danish Institute of Agricultural Sciences (Departments of Agricultural Systems, Crop Physiology and Soil Science, Animal Health and Welfare, Agricultural Engineering), Danish Research Institute of Food Economics, and The national Committee for Pig Production.

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### 5. Other project staff

Jørgen Eriksen, Department of Crop Physiology and Soil Science, DIAS  
Merete Studsnitz, Department of Animal Health and Welfare, DIAS  
Karin Strudsholm, Departments of Agricultural Systems, DIAS  
Bent Hindrup Andersen, Department of Agricultural Engineering, DIAS  
Niels Tvedegaard, Danish Research Institute of Food Economics  
Vivi Aarestrup Moustsen, Danish Bacon & Meat Council

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### 6. Project period (month, year)

Start of project:	1.8.2001
End of project:	31.12.2004

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## Midterm description of the project, its results and progress, and application for continuation in 2003

### A. Project summary

In Denmark, the organic pig production is very scarce today and need to be developed in order to fulfil the expected potential hereof. In relation to this there is a need to develop new systems in which the pig production is more integrated into land use in order to fulfil the expectation to the organic pig production from different stakeholders and probably also in order to make the production economical feasible.

In the preliminary work for this research initiative, two in principle different systems have been suggested as alternatives to the dominant way of production of organic pigs today. Today, the sows are outdoors on pasture whereas the growing pigs are indoors with access to an outdoor run of limited size. The two alternatives are characterised by either mobile huts, which can be moved in an appropriate way in the crop rotation allowing the pigs to forage, or by establishment of decentralized, strategically positioned fixed units, where the pigs have easy access to the surrounding area.

However, such a development raises several questions, which are being addressed in this project. The project has three work packages (WP). The first WP focuses on grazing strategies for sows and growing pigs. Through two experiments, it is expected that we can 1. Propose alternatives to ringing of sows in the effort to maintain sward quality, and 2. Propose appropriate strategies of combining grazing and barn feeding for growing pigs.

The second WP focuses on the environmental impact of different grazing regimes. In the before mentioned experiments with sows and growing pigs, the level and spatial variation in nutrient load of the grazing areas will be determined (N, P and K) and the distribution between N-losses as leaching, ammonia volatilization and denitrification will be estimated. Furthermore, different pig production systems will be assessed in relation to nutrient losses through strategic sampling on the area grazed. Hereby it is expected that strategies for improved nutrient utilisation and an acceptable environmental load of nutrients in organic pig production can be proposed.

The third WP includes an overall assessment of different pig production systems within a life cycle assessment (LCA) framework and also including economic considerations. Suitable LCA indicators will be selected and data will be collected from commercial organic farms as well as from experimental units. Through modelling a range of systems will be assessed not only including the actual systems already present but also 'future' relevant systems improved with the knowledge obtained in other WPs in this project.

**Table 1: Work package list (from application).**

No.	Work package title	Participants*	Budget (1.000 DKr)	Start	End	Deliverable No:
1	Strategies for grazing systems in organic pig production	<u>KSU</u> , MS	1,147	Oct 2001	April 2004	D1.1-D1.3
2	Nutrient load and environmental consequences of pigs on grassland	<u>JE</u>	1,036	Jan 2002	Aug 2004	D.2.1-D2.3
3	System assessment in an LCA perspective and co-ordination	<u>JHE,NT</u> , <u>KSU</u> , <u>BHA,VAL</u>	1,317	Aug 2001	Dec 2004	D3.1-D3.5
<b>Total</b>			3,500			

\* Responsible participants are underlined

### B. Objectives and expected achievements

The overall perspective of the project is to create knowledge, which can support the development of organic pig production in Denmark. This implies knowledge on how the system at farm level can be con-

structured so that the production is economically feasible for the farmer and at the same time respects the farmers' and the consumers' perception of the organic ideals as well as societal goals for environmental impact of animal production. The objectives are, during experiments, farm studies, and modelling:

- to identify optimal strategies for growing pigs at pasture combined with a possible barn fed period in relation to growth, nutrient load at the pasture and an appropriate utilisation of the farm buildings,
- to identify appropriate strategies for keeping sows on pasture without being ringed in relation to sward quality and risk of nutrient losses,
- to quantify the risk of nutrient losses in a range of grazing systems with particular focus on 'improved' grazing strategies,
- to assess different systems in relation to production efficiency, resource use, and environmental impact within an LCA framework,
- to propose an economically and environmentally viable future strategy for organic pig production in Denmark.

## **C. Midterm results and progress**

### **C.1 Description (summary) of main results and conclusions**

#### ***WPI: Strategies for grazing systems in organic pig Production***

Two experiments have been planned according to the application and are in progress now.

*The first experiment* concerns investigation of different strategies for combined grazing and barn kept growing pigs in relation to growth rate, behaviour and meat quality and is carried out at the organic experimental station, Rugballegaard. In five replicates with a flock size of ten pigs balanced in live weight and sex the experiment described below is carried out. At weaning at an age of 7-8 weeks (app 20 kg) piglets born in an outdoor system were distributed on five treatments:

1. Piglets are moved indoor at weaning and fed ad libitum until slaughter.
2. Piglets stay on pasture and are fed restrictively with concentrates until 40 kg live weight, followed by ad libitum feeding in a barn pen.
3. Piglets stay on pasture and is fed restrictively with concentrates until 80 kg live weight, followed by ad libitum feeding in a pen.
4. Piglets stay on pasture until slaughtering and is fed restrictively in the whole period.
5. As treatment 4, but the growers are fed ad libitum until slaughtering.

The first replicate started January 2002 and the fifth and last replicate is expected to start in December 2002, so that the seasonal variation is expected to be covered by the design. All finishers in the second replicate are now slaughtered and the third and fourth replicate is under execution.

In the field each experimental unit (group of ten pigs) is allocated to a 'new' piece of land, differing in size according to the expected nutrient load from the pigs. The stocking rate in the field was calculated to cause 280 kg N per hectare. To ensure a good distribution of the manure and thereby the environmental load from the pigs on the pasture, the huts, troughs and water supply are moved in a routine.

All the pigs are individually weighed at weaning, at transmission and at slaughtering. The pigs in treatment 1 are also weighed when pigs in treatment 2 and 3 are moved indoor to estimate the compensatory growth. At the same time points, the social and aggressive behaviour are registered for all treatments. At slaughter the carcass is evaluated for lean percentage and back fat. Furthermore, as a result of additional funding outside FØJO, the colour, the tenderness and the fatty acid composition of the neckpiece is measured.

Until now production results have been good with a low mortality, high meat percentage and a satisfactory feed conversion in all treatments in the first replicate.

*The second experiment* concerns investigation of environmental impact of ringed sows compared to pasture control. The study is carried out at a private farm and includes three treatments:

- 1: nose-ringed sows
- 2: unringed sows
- 3: unringed sows subjected to pasture control

The stocking density estimated per year is the same in the three treatments, but in the treatment of pasture control the sows admittance to the field is limited to one half from May until June and to the second half from July until September. All three treatments include pregnant (2 replicates) as well as nursing sows (3 replicates). Pregnant sows are housed in groups of five, whereas nursing sows are housed in single farrowing pens. The experiment started in May and the last observations and samplings are just completed in September.

The behaviour of the sows is registered once a week. Rooting behaviour, grazing, level of activity and location of the sow is recorded in zones in the fields corresponding to the zones where the grass cover is measured by telemetry in July and in September. Input-output of plant nutrients in the pens are recorded.

## ***WP2: Nutrient load and environmental consequences of pigs on grassland***

### *1 Environmental impact of growing pigs on pasture*

In the experiment on outdoor growing pigs at Rugballegaard (see WP1) soil samples have been collected and grass cover evaluated each time pigs were transferred from the field to housing or slaughterhouse. Gridpoints were established for every 5x5 m in the 10 m wide paddocks and similarly points were established outside the paddocks for every 5 m as a reference. In each point soil samples were collected to 40 cm by pooling 8 soil cores. These will be analyzed for content of mineral N, exchangeable K and extractable P to determine the level and the distribution of nutrients within the paddocks. Grass cover in all points was originally planned to be a visual inspection but is now instead carried out using automatic measurements of spectral reflectance from which a relative vegetation index (RVI) can be calculated. We consider this a huge improvement as the data seems very reliable, more precise and the subjective and individual nature of visual determination is avoided. Generally, it has been difficult to maintain a grass cover in the paddocks. Next spring all paddocks are ploughed and a cereal crop put in. The growth of the crop will be determined in all grid points.

### *2 Environmental impact and pasture damage without nose-ringing of sows*

In the experiment established at a private farm (see WP1) spectral reflectance of grass cover have been determined during summer grazing and at the end of the experiment to determine the influence of nose-ringing and animal density in paddocks with pregnant and lactating sows. At the end of grazing, soil sampling was carried out in sub-units of each paddock for analysis of mineral N, exchangeable K and extractable P to determine the level and the distribution of nutrients within the paddocks. Determination of grass cover and soil sampling strategy has been coordinated with animal behavior studies.

### *3 Characterization of environmental impact of different production systems*

Following the end of the above experiments, nutrient surpluses will be calculated and related to the recovery of the mineral nutrient found in the paddock and the grass cover. In a number of different systems strategic sampling will be carried out to identify critical points.

## ***WP3: System assessment in an LCA perspective and co-ordination***

The concept of LCA has been consolidated through the project leaders participation in an other project "Life cycle assessment of basic foods" and the necessary protocol for collecting the relevant input-output data has been established. Data are being obtained from different sources at the moment through participation in several other projects regarding organic pig production. In this way the basis for carrying out LCA's for systems widely differing in resource use (including land use and buildings)

are established. These include systems where sows are kept on grass and finishers in barns with an outdoor run, systems based on a one unit pen (strategical placed units where the pigs (sows and finishers) have easy access to the surrounding area)) and systems where sows as well as finishers are kept in the crop rotation all year round.

A forum has been established where practitioners, slaughterhouses, advisors and researchers can discuss the progress and perspectives in the range of research and development projects in progress at the moment (see G). This forum is also valuable in suggesting what new systems which should be evaluated in this WP.

## C.2 Fulfilment of deliverables and milestones

<b>WP1: Strategies for grazing systems in organic pig Production</b>	Time schedule according to application	Deviations, if any*
<b>Deliverables</b>		
1 – Paper on rooting by unringed pregnant sows	Dec 03	
2 - Paper on comparison of four strategies for grazing/housing of weaners and finishers	Dec 03	
3 – Project report on proposed optimal strategies for pigs grazing management to be used in system analyses	Jan 04	

<b>Milestones</b>		
1 – Design of experiments concluded in the entire project group ( including determination of the relevant stocking rate and feeding strategies to be used for different groups of pigs)	Dec 01	
2 – Completion of experiment covering activity 1	June 03	
3 – Completion of experiment covering activity 2	June 03	

- *Deviations are to be further discussed at C3*

<b>WP2: Nutrient load and environmental consequences of pigs on grassland</b>	Time schedule according to application	Deviations, if any*
<b>Deliverables</b>		
1 – Paper on the nutrient losses related to different strategies for keeping growing pigs on grassland.	Feb 04	
2 – Paper on the effect of nose-ringing of sows on pasture damage and nutrient utilization.	March 04	
3 – Estimates of nutrient losses from grassland in different outdoor pig production systems to be used in system analyses.	April 04	
<b>Milestones</b>		
1 – Environmental guidelines for keeping growing pigs on pasture have been developed and published	Sept 04	
2 – Environmental recommendation for nose-ringing of sows have been developed and published	Sep 04	

\* *Deviations are to be further discussed at C3*

<b>WP3: System assessment in an LCA perspective and co-ordination</b>	Time schedule according to application	Deviations, if any*
<b>Deliverables</b>		
1 – Report on relevant indicators for an LCA assessment	Feb 02	April 03

2 – Paper on LCA and economics of different systems	Oct 04	
3 – Report on future proposed systems	Nov 04	
4 – Annual status report for the project	Nov 01,02,03	
5- National meeting with advisors and producers/producer organisations interested in organic pig production	Nov 04	
<b>Milestones</b>		
1 - A set of indicators discussed in national and international fora and agreed upon in the project group	March 02	
2 - Co-operation with the farmers established and recording scheme developed	Sept 01	Dec 01
3 – Conceptual model developed	Dec 02	June 03
4 - A series of analyses carried out	Sept 04	

\* Deviations are to be further discussed at C3

## D. Description of deviations and subsequent adjustments of plans

The conceptual work regarding LCA have been delayed. This will, however, have no influence on the overall work plan and for finalizing the project according to the original plan.

## E. Project publications and other products

### 1. Articles in international, scientific journals with review procedures

Eriksen J., Petersen S.O. & Sommer S.G. (2002): The fate of nitrogen in outdoor pig production. *Agronomie*. In press. \*\*

### 2. Papers presented at congresses, symposiums, etc.

Hermansen, J.E., Larsen, V.A. & Andersen, B.H., 2002: Development of organic pig production systems. Presentation at "Perspectives in Pig Science" Conference, Nottingham, September 2002, 15 pp.\*\*

Hermansen, J.E., 2001: Organic livestock production systems and appropriate development in relation to public expectations. Paper presented at 52<sup>nd</sup> EAAP meeting, Budapest, August 2001, p. 219.

### 3. Reports, articles in agricultural journals, etc.

Studnitz, M., 2002: Nytt trynering overhovedet? *UdendørsNyt* nr.2, side 8.

Studnitz, M., 2002: Forsøg med slagtesvin. *UdendørsNyt* nr.2, side 10-11.

Studnitz, M., 2002: **Har søers rodeintensitet indflydelse på udvaskning? Landsbladet Svin nr. 8, side 32.**

### 4. Oral presentations, public meetings, field days, etc.

Eriksen, J. & S.O. Petersen. Poster at field day in Foulum 13 June 2002: "Miljøbelastning ved søer på friland"

Hermansen, J.E., 2001: Rammer og udfordringer for frilands- og økologisk svineproduktion. Økologisk og udendørs svineproduktion. Hvor står vi? Temamøde på Danmarks Jordbrugs-Forskning den 21. august 2001. Intern Rapport nr. 145. P. 4-8\*\*.

Strudsholm, K., Studnitz, M., 2002: Poster at field day Rugballegård.

Studnitz, M., 2002: Ved naturvidenskabsfestivalen og Åbent hus arrangement den 28. september på stand ved HSV.

## **F. Scientific education including visiting scientist**

During a period of 3 month in 2002 Cecile Cornou from France will be employed in the project as part of her preparation for application PhD.-grant. Cecile Cornou has a M.Sc. in Agricultural Science (2002) with main focus on system analysis, statistics and economy.

## **G. National and international cooperation**

### *National collaboration*

In relation to the heading of a development project concerning organic pig production (the project leader for PIGSYS) has organised a support group with a wide range of stake holders. These include:

- Central Advisory Service (Erik Nørgård)
  - The Organic Agricultural School (Simme Eriksen)
  - Organic Pig Producers Council (LØK) (Fie Graugård, Poul Skovgård, Tove Seerup)
  - The Animal Protection Agency (Pernille F. Johnsen)
  - Slaughterhouses Handling Organic Pigs (Karsten Dejbjerg (Danish Crown), Ulrich Kern-Hansen (Hanegal))
  - Plant Directorate (Kim Boesen)
  - Danish Slaughterhouses (Henrik B. Lauritsen)
- as well as project participants (researchers) in different projects.

The overall idea is to discuss prospects and constrains for the development of organic pig production with a special emphasis on the primary production. This includes demand for new knowledge on the detailed level as well as on new production systems which to a higher degree than at present can comply with the expectation of consumers and other stake holders. This is expected also to give important input to the overall analysis which is going to take place in PIGSYS.

Below is given research and development projects outside FOEJO funded projects which are discussed in the support group

- New organic pig production system (2001-2004)
- Concept for huts on protected – deep litter based areas for combined farrowing sows and weaners (2002-2004)
- Optimised welfare for organic pig production in tent systems as well as farrowing huts (2002-2004)
- Entire male production – influence on welfare aspects and risk for boar taint (2002-2004)

## **H. Critical reflection on the project**

The project group finds that the background, the perspective and the way the work is carried out still is sound and valid in relation to the challenges which exists for the development of organic pig production. It is also worth to notice that the present research fit very well the development activities, which at the same time takes place.

## 8. Budget

### A. Account for any change in budgets

Due to delay in the work concerning LCA 3 man-month has been postponed from 2002 to coming years. Also some analytical costs have been postponed from 2002 to 2003. In total the consumption in 2002 is 221.000 DKK less than originally planned and the expected consumption in 2003 and 2004 increased accordingly.

### B. Budget for the whole project (1.000 DKK)

Total consumption of funds from DARCOF and expected consumption this year and coming years

Year:	Consumption before 2002	Expected consumption 2002	2003	2004	2005	Total
Man-months						
Scientific personnel	1,5	12,5	16	17		47
Technical personnel	0	11	6	1		18

Year:	Consumption before 2002	Expected consumption 2002	2003	2004	2005	Total
Salaries						
Scientific personnel	52	441	591	688		1772
Technical personnel	0	256	148	25		429
Other operational costs	5	141	289	130		565
Equipment						
Others (please specify)	5	35	30	30		100
Direct costs	68	889	1074	893		2924
Indirect costs (20% of direct costs)	13	178	215	179		585
Total	81	1067	1289	1072		3509

**Comments:**

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## 9. Signatures and stamps

Name	Institute	Date	Signature
Head of project			

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## Appendix I. Detailed budget

### A. Budget for each participating institute (1.000 DKr)

Name of Institute: DIAS

Year:	Consumption before 2002	Expected consumption 2002	2003	2004	2005	Total
Man-months						
Scientific personnel	1	10,5	14	14		39,5
Technical personnel	0	11	6	1		18

Year:	Consumption before 2002	Expected consumption 2002	2003	2004	2005	Total
Salaries						
Scientific personnel	35	371	519	578		1503
Technical personnel	0	256	148	25		429
Other operational costs	5	141	289	130		565
Equipment						
Others (please specify)	5	35	30	30		100
Direct costs	45	803	986	763		2597
Indirect costs (20% of direct costs)	9	161	197	153		520
Total	54	964	1183	916		3117

**Comments:**

Name of Institute: FØI

Year:	Consumption before 2002	Expected consumption 2002	2003	2004	2005	Total
Man-months						
Scientific personnel	0,5	2	2	3		7,5
Technical personnel						

Year:	Consumption before 2002	Expected consumption 2002	2003	2004	2005	Total
Salaries						
Scientific personnel	17	70	72	110		269
Technical personnel						
Other operational costs	6	16	16	20		58
Equipment						
Others (please specify)						
Direct costs	23	86	88	130		327
Indirect costs (20% of direct costs)	4	17	18	26		65
Total	27	103	106	156		392

## B. Budget for each participating department (1.000 DKK)

Name of Institute and department: DIAS, PVJ

Year:	Consumption before 2002	Expected consumption 2002	2003	2004	2005	Total
Man-months						
Scientific personnel		2	2,5	5		9,5
Technical personnel		4	3			7

Year:	Consumption before 2002	Expected consumption 2002	2003	2004	2005	Total
Salaries						
Scientific personnel		84	111	234		429
Technical personnel		99	76			175
Other operational costs		16	183	60		259
Equipment						
Others (please specify)						
Direct costs		199	370	294		863
Indirect costs (20% of direct costs)		40	74	59		173
Total		239	444	353		1036

**Comments:** The analysis of soil nutrient content will be carried out in one batch in 2003, when sampling has finished. Therefore the cost of the 2002 analysis (84.000 kr) and indirect costs (17.000 kr) has been transferred from 2002 to 2003.

Name of Institute and department: DIAS, JBS

Year:	Consumption before 2002	Expected consumption 2002	2003	2004	2005	Total
Man-months						
Scientific personnel	1	4,5	6,5	6		18
Technical personnel	0	4	3	1		8

Year:	Consumption before 2002	Expected consumption 2002	2003	2004	2005	Total
Salaries						
Scientific personnel	35	163	241	234		673
Technical personnel	0	91	72	25		188
Other operational costs	5	105	70	40		220
Equipment						
Others (please specify)	5	35	30	30		100
Direct costs	45	394	413	329		1181
Indirect costs (20% of direct costs)	9	79	82	65		235
Total	54	473	495	394		1416

Due to delay in the work concerning LCA 1½ man-month has been postponed from 2002 to coming years.

Name of Institute and department: DIAS, HSV

Year:	Consumption before 2002	Expected consumption 2002	2003	2004	2005	Total
Man-months						
Scientific personnel		4	3	1		8
Technical personnel		3	0	0		3

Year:	Consumption before 2002	Expected consumption 2002	2003	2004	2005	Total
Salaries						
Scientific personnel		124	94	33		251
Technical personnel		66	0	0		66
Other operational costs		20	20	10		50
Equipment						
Others (please specify)						
Direct costs		210	114	43		367
Indirect costs (20% of direct costs)		42	23	9		74
Total		252	137	52		441

Name of Institute and department: DIAS, JBT

Year:	Consumption before 2002	Expected consumption 2002	2003	2004	2005	Total
Man-months						
Scientific personnel			2	2		4
Technical personnel						

Year:	Consumption before 2002	Expected consumption 2002	2003	2004	2005	Total
Salaries						
Scientific personnel			73	77		150
Technical personnel						
Other operational costs			16	20		36
Equipment						
Others (please specify)						
Direct costs			89	97		186
Indirect costs (20% of direct costs)			18	20		38
Total			107	117		224

Due to delay in the work concerning LCA 2 man-month has been postponed from 2002 to coming years.

**C. Budget for co-financing from each participating institute (1.000 DKK)**

Name of Institute:

Year:	Consumption before 2002	Expected consumption 2002	2003	2004	2005	Total
Man-months						
Scientific personnel						
Technical personnel						

Year:	Consumption before 2002	Expected consumption 2002	2003	2004	2005	Total
Salaries						
Scientific personnel						
Technical personnel						
Other operational costs						
Equipment						
Others (please specify)						
Direct costs						
Indirect costs (20% of direct costs)						
Total						

**Comments:**