Annual Status Report 2001 and Application for Continuation in 2002

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

---

1. Research program
Research in organic farming 2000-2005 (DARCOF II)

---

2. Project title and number
CRUCIAL – Closing the Rural Urban Nutrient Cycle (III.3)

---

3. Head of project
Jakob Magid, Department of Agricultural Sciences - KVL

---

4. Participating institutes

DJF	Danish Institute of Agricultural Sciences
DMU	National Environmental Research Institute
FSL	Danish Forest and Landscape Research Institute
KVL	Royal Veterinary and Agricultural University

---

5. Contact persons

DMU	Poul Henning Krogh, Senior Researcher
FSL	Jakob Møller, Senior Researcher
DJF-Foulum	Bent T. Christensen, Research Specialist

---

6. Other project staff

KVL	Simon Wrisberg, Lars Stoumann Jensen

---

7. Start of project: August 2001
End of project: April 2006

8. Annual report/Application for continuation in 2001

A. Objectives and expected achievements (from application)

1. To provide a field-scale facility for assessing the feasibility of improved recycling of nutrients from urban areas to organic farms
2. To facilitate the process of sustainable urban development, by inviting the public to visit the Long-term Trials (Public relations)
3. To gain basic knowledge regarding co-composting of municipal solid waste and human faeces, with special emphasis on the effect of different mixing ratios and addition of green waste as structural material on self heating capacity, nitrogen loss and oxygen consumption.
4. To determine the influence of different temperature regimes on compost quality (nitrogen availability, compost maturity) including comparison of thermophilic composting versus mesophilic composting practice.
5. To provide sufficient amounts of composted material for the field trials using the traditional organic 'Indore' practise as well as modern composting practises
6. To perform a comprehensive mesocosm study on urban fertiliser impact on nutrient cycling where the temporal and spatial dynamics of plant nutrient cycling is linked to the biological activity of soil organisms
7. To provide experimental data for modelling plant nutrient dynamics of soil receiving urban fertilisers via incubation studies and the mesocosm study mentioned above
8. To parameterise selected urban fertilisers to the DAISY model and test the explanatory / predictive power of this model by simulating the detailed measurements from the field trials
9. To assess the availability of P in urban wastes and characterize the fertilizer value of waste-derived P following introduction to arable soil
10. To deliver an initial characterisation of soil quality in the field experiment
11. To initiate a long-term monitoring of soil biological quality in the field experiment

B. Project summary (from application)

In society as a whole there is a wish to support a sustainable development. In recent years the public has been concerned with agriculture, and the population has been particularly supportive of organic farming in their consumer behaviour. To this date there has been rather less concern with the sustainable functioning of the urban areas, and only a few persons have started to talk about 'organic cities'. However it is generally recognised that the urban areas are practically dissociated from the rural areas when looking at returning nutrients. Recently organic farmers refused to accept sewage sludge, and conventional farmers followed suite for a time, which led to severe problems in the urban areas.

This proposal forms part of a coherent effort to re-invent urban waste management with the view to close the rural urban nutrient cycle. It will ensure the establishment of a field-scale facility for assessing the feasibility of improved recycling of nutrients from urban areas to organic farms, in the form of a long-term field trial. With its emphasis on urban fertiliser pre-treatment, turnover in soil and impact on crop growth, it will provide practically useful results. With the initiation of a monitoring programme for biological soil quality it will attempt to take eventual unforeseen ill effects of increased re-circulation into account. Additionally it will provide support to planned research on human and animal health aspects, in connection with agricultural waste utilisation. Finally the work presented in this proposal will provide at concrete platform for the public debate, and possibilities for the public to visit the field trials.

Table 1: Work package list (from application)

Work-package No *)	**Work package title**	**partici-pants**	**Budget DK kkr.**	**Start**	**End**	**Deliver-able No:**
1	Establishment and running of Long-term field trials with urban fertilisers	KVL	1600	2001	2006	1-6
2	Development of composting practises for food waste and human faeces	FSL, KVL	750	2001	2004	7-10
3	C and N dynamics of urban fertilisers	KVL, DMU	1818	2002	2005	11-18
4	Agronomic research on P and K turnover in soil with applied Urban Fertilisers and its subsequent availability in pot trials	DJF	462	2003	2004	19-21
5	Soil quality monitoring programme	DMU, KVL	1000	2001	2005	22-25

*) The number of workpackages has been reduced from 6 to 5 due to budget restrictions. Subsequently the number of deliverables have been reduced, and an updated list of deliverables is attached at the end of this document

C. Progress

C.1 Annual description (resume) of main results and conclusions

A basic dataset on soil quality of the 11 hectare field is being generated

Protocols are being developed for the individual urban fertiliser trials, including letters of agreements with parties that can deliver needed inputs.

A protocol for composting household waste together with human faeces sludge has been developed

Acquisitions of urban fertilisers are more costly than originally anticipated, due to high transportation costs

Within the auspices of the Nordic Agricultural Research Forum a workshop was organised by the CRUCIAL project on 20th - 21st of August on 'URBAN AREAS - RURAL AREAS AND RECYCLING– THE ORGANIC WAY FORWARD?' A DARCOF proceedings will be published based on 15 contributions from Scandinavian and international researchers in the field

C.2 Fulfilment of tasks and deadlines in individual work packages

(To be completed for each work package)

WP1 Establishment and running of Long-term field trials with urban fertilisers	Time schedule	Deviations, if any*
Task		
1 To provide field-scale facility for assessing the feasibility of improved recycling of nutrients from urban areas to organic farms	2001 – 2006	
2 To facilitate the process of sustainable urban development, by inviting the public to visit the Long-term Trials (Public relations)	2001 – 2006	
Deliverables		
1-4 Annual reports 2001-2004	2001 – 2005	
5 Materials and protocol for guided tour (public relations)	May 2002	
6 Report on crop yields and quality, and soil N_{min} status over 2002 – 2004 (input needed in WP3)	Jul 2004	

Milestones		
1 Establishment of permanent grass strips	Oct. 2001	
2 Spreading of fertiliser with high N availability (to be repeated yearly)	Apr. 2002 – 2006	
Sowing of crops (to be repeated yearly)	Apr. 2002 – 2006	
Characterization of crop growth (to be repeated yearly)	May - August 2002 – 2005	
Public presentation of the field experiment ((to be repeated yearly, and on request)	Jun. 2002 – 2005	
Spreading of fertilisers with low N availability (to be repeated yearly)	Nov. 2002 – 2005	

** Deviations are to be further discussed at C3*

WP2 Development of composting practises for food waste and human faeces	Time schedule according to application	Deviations, if any*
Task		
1 To gain basic knowledge regarding co-composting of municipal solid waste and human faeces, with special emphasis on the effect of different mixing ratios and addition of green waste as structural material on self heating capacity, nitrogen loss and oxygen consumption.	2001 – 2004	
2 To determine the influence of different temperature regimes on compost quality (nitrogen availability, compost maturity) including comparison of thermophilic composting versus mesophilic composting practice	2001 - 2004	
3 To provide sufficient amounts of composted material for the field trials using the traditional organic 'Indore' practise as well as modern composting practises	2001 - 2004	
Deliverables		
Composted MSW and faeces for use in the field experiment each year from autumn 2002	Oct 2002 & onwards	
Report on best practice for full-scale co-composting of municipal solid waste and human faeces based on laboratory scale experiments and trials with meso-scale experiments on KVL's experimental station	Dec 2003	
Presentation at conference	2004	
Scientific manuscript on composting trials	Jul 2004	
Milestones		
Establishment of a composting facility at KVL's experimental station	Apr. 2002	
First meso-scale composting trial completed (to be repeated each year)	Oct. 2002	
Laboratory studies on composting completed	July 2003	

Work Packages 3 and 4 have yet to be initiated due to the 1 year delay of the project

WP5 Soil quality monitoring programme	Time schedule according to application	Deviations, if any*
Task		
To deliver an initial characterisation of soil quality in the field experiment	2001 – 2005	
To initiate a long-term monitoring of soil biological quality in the field experiment	2001 – 2005	
Deliverables		
Contributions to status and final project reports	Oct 2002 & onwards	
Report on soil characteristics, and motivated recommendation for the lay-out of the field trials	Dec 2002	
Report on urban fertiliser impact on soil quality	2004	
Milestones		
Establishment of soil archive	Sep. 2001	
Layout of plots	Oct. 2001	
Sampling of plots for faunal and other biological characterisation (soil quality baseline study)	Oct. 2002	
Completed baseline study	Mar. 2003	
Sampling of plots for faunal and other biological characterisation	Aug. 2004	
Completed soil quality impact study after 3 years of treatment/fertilisation	Oct. 2005	

C.3 Discussion on the progress, incl. deviations and achievements in the project as a whole and in the individual work packages and

The final decision to initiate the project was delayed in the Ministry of Agriculture, and the letter of grant was only released in the end of April 2001. Therefore there was a full year delay in the commencement of the project that has been running since 1st August this year. Thus at this point in time we have been working for less than 3 months, and the project is still in its inception phase.

We have not yet encountered any substantial problems or difficulties that can affect the project implementation

Given that the project is intended to initiate a long-term experiment, we wish to be given permission to extend the project life to April 2006, in line with the intention of the original application, that allowed the completion of 4 growth cycles, and the initiation of a 5th cycle. For some reason the ministry has indicated that the project should completed by 2004 in the letter of grant (20th April 2001), but we strongly recommend a longer project completion period, in line with the intention of the original project proposal.

D. Description of plans and future work in the project as a whole and in the work package (Including plans for publication and communication)

Currently we are attempting to strengthen WP1-3 through an application to EU's Life program, and we would like to strengthen WP3 with a PhD student (joint between DMU and KVL) from the SOAR school. Should we be successful in attracting additional funding, it would be highly relevant to extend the project life one year further (2005).

E. Project publications

1. Articles in international, scientific journals with review procedures

   Premature

2. Presentations at congresses, symposiums etc.

   Within the auspices of the Nordic Agricultural Research Forum a workshop was organised by the CRUCIAL project on 20th - 21st of August on 'URBAN AREAS - RURAL AREAS AND RECYCLING– THE ORGANIC WAY FORWARD?' A DARCOF proceedings will be published based on 15 contributions from Scandinavian and international researchers in the field

3. Articles in agricultural journals etc.

   A National Daily Newspaper (Berlingske):
   Andersen Pauli: Forskere ser en guldgrube i de danske kloakker. Berlingske fredag d. 5 oktober 2001

   From the Danish Center for Urban Ecology:
   Wrisberg Simon, Eilersen Ann Marie: Nye håndteringssystemer til recirkulering af spildevand og organisk affald fra byer. Foreningen Dansk Byøkologi juni 2001. nr.2 årgang 4.

4. Other presentations at meetings, field days etc.

   Presentations for 2 high-school groups on separate occasions in September 2001, Jakob Magid, KVL

   Association of Organic Farmers theme lectures 7th November 2001
   Nutrients in circulation – how can urban fertilisers contribute, Jakob Magid, KVL

F. Scientific education (ph.d. and post doc.), including visiting scientists and visits abroad

Premature

G. National and international co-operation

Participation in ORIO – a Nordic training and educational network on eco-sanitation development, headed by Petter Jenssen, NLH, ÅS, Norway (2001-2002)

H. Possible elaboration of project and achieved results

Premature

9. Budget

A. Account for any change in budgets

We seek permission to extend the project life into 2006, given that the initiation of the project is a year delayed, and that the project is a long-term venture.

This change in the budget is in line with the intention of the original application, that allowed the completion of 4 growth cycles, and the initiation of a 5th cycle.

B. Budget for the whole project (1.000 DKr)

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

	2001	2002	2003	2004	2005	2006	Total
Man-months	0.5	1.0	1.1	1.0	1.0	1.5	6
Scientific personnel	4.7	14.4	21.8	19.2	14.3	1.6	76
Technical personnel	1.3	6.2	10.8	8.6	2.0	1.6	31

All institutions	2001	2002	2003	2004	2005	2006	Total
Salaries							
Salary (coordination)	20	50	43	45	35	35	228
Scientific personnel	158	493	739	670	501	57	2618
Technical personnel	33	151	258	231	51	40	764
							0
Other operational costs	62	110	140	120	60	40	532
Transport af 'By-gødninger'		25	27	28	29	25	134
Special field operations		35	35	35	35	20	160
Composting facility and equipment		75	50				125
Characterisation of the experimental field		60	70				130
Direct costs	273	1000	1362	1129	711	217	4692
Indirect costs (20% of direct costs)	55	200	272	226	142	43	938
Total	328	1199	1635	1355	853	260	5630

Comments:

C. Budget for each participating institute (1.000 DKr)

Institution 1 (KVL)	2001	2002	2003	2004	2005	2006	Total
Salary (coordination)	0.5	1.0	1.1	1.0	1.0	1.5	6.2
Scientific personnel	2.5	8.0	11.5	11.7	10.2	1.6	45.5
Technical personnel	0.9	2.9	4.1	2.5	2.0	1.6	14.0

Institution 1 (KVL)	2001	2002	2003	2004	2005	2006	Total
Salaries							
Salary (coordination)	20	40	43	35	35	55	228.00
Scientific personnel	80	270	374	405	351	57	1537.00
Technical personnel	22	72	90	79	51	40	354.00
Other operational costs	50	70	70	70	45	40	345.00
Transport af 'By-gødninger'		25.4	27	28	29	25	134.40
Special field operations		35	35	35	35	20	160.00
Composting facility and equipment		75	50				125.00
Characterisation of the experimental field		60	70				130.00
Direct costs	172	647.4	759	652	546	237	3013.40
Indirect costs (20% of direct costs)	34.4	129.48	151.8	130.4	109.2	47.4	602.68
Total	206.4	776.88	910.8	782.4	655.2	284.4	3616.08

Institution 2 (DMU)	2001	2002	2003	2004	2005	2006	Total
Scientific personnel	0.5	3.2	4.3	3.3	4.2		15.6
Technical personnel	0.4	3.2	4.3	3.5	0		11.5

Institution 2 (DMU)	2001	2002	2003	2004	2005	2006	Total
Scientific personnel	18	113	155	120	150		556.47
Technical personnel	11	79	107	88	0		284.78
Other operational costs	2	25	25	25	15		92.00
Direct costs	31	217	287	233	165		933.25
Indirect costs (20% of direct costs)	6	43	57	47	33		186.65
Total	37	261	345	280	198		1119.89

Institution 3 DJF Foulum	2001	2002	2003	2004	2005	2006	Total
Scientific personnel	0	0	2.9	3.1	0		6.0
Technical personnel	0	0	2.4	2.6	0		5.0

Institution 3 DJF Foulum	2001	2002	2003	2004	2005	2006	Total
Scientific personnel			100	110			210.00
Technical personnel			61	64			125.00
Other operational costs			30	20			50.00
Direct costs			191	194			385.00

Indirect costs (20% of direct costs)			38	39			77.00
Total			229	233			462.00

Institution 4 FSL	2001	2002	2003	2004	2005	2006	Total
Scientific personnel	1.7	3.1	3.1	1.0	0		9.0
Technical personnel							

Institution 4 FSL	2001	2002	2003	2004	2005	2006	Total
Scientific personnel	60	110	110	35			315.00
Other operational costs	10	15	15	5			45.00
Direct costs	70	125	125	40	0		360.00
Indirect costs (20% of direct costs)	14	25	25	8	0		72.00
Total	84	150	150	48	0		432.00

Comments:

D. Budget for each participating department (1.000 DKr)

See above under C. Budget for each participating Institute

E. Budget for co-financing from each participating institute (1.000 DKr)

Name of Institute: KVL – Department of Agricultural Sciences KVL-DAS)

Year	2001	2002	2003	2004	2005	2006	Total
Scientific personnel	0.5	0.5	0.5	0.5	0.5	0.25	2.5
Technical personnel	1.0	1.0	1.0	1.0	1.0	0.5	5.0

Year	2001	2002	2003	2004	2005	2006	Total
Scientific personnel	18	18	18	18	19	10	101
Technical personnel (basic field operations)	22	23	23	24	24	12	128
Alternative costs using 11.5 hectares	92	96	100	103	108	111	610
Use of machinery	25	26	27	28	29	15	150
Direct costs	157	163	168	173	180	148	989
Indirect costs	31	33	34	35	36	30	198
Total financing from KVL-DAS	188	196	202	208	216	178	1187

Comments:

10. Signatures and stamps

Name	Institute	Date	Signature
Head of project			

11. Fyldigt dansk sammendrag af indsatsen i forskningsprojektet

Beslutningen om igangsættelse af projektet blev udsat i Direktoratet for Fødevare Erhverv og bevillingsskrivelsen først afsendt i slutningen af April 2001. Derfor er projektet 1 år forsinket, og har kun været i gang siden August 2001. Således har vi i skrivende stund været i gang i mindre end 3 måneder, hvorfor projektet er i sin indledende fase.

Da projektet er langsigtet vil ønsker vi tilladelse til at lade projektet løbe frem til april 2006, for at undgå en afkortning af forløbet som det oprindeligt var planlagt.

I løbet af projektets første 3 måneder er følgende resultater nået:

Et data sæt vedr. jordkvaliteten på de 11 hektar forsøgsmark er ved at blive oparbejdet.

Protokoller for de enkelte bygødningsforsøg er under udarbejdelse, inkl. skriftlige aftaler med leverandører af relevante bygødninger

Der er udarbejdet en protokol for kompostering af husholdningsaffald sammen med human fæces slam

I regi af Nordisk Jordbrugsforsker Forening blev der afholdt en workshop 20-21 August med titlen 'URBAN AREAS - RURAL AREAS AND RECYCLING– THE ORGANIC WAY FORWARD?' Workshoppen var organiseret med af CRUCIAL projektet. Der vil blive udgivet en FØJO rapport med bidrag fra 15 oplægsholdere.

Projektet er i sin indledende fase ikke stødt in i væsentlige forhindringer eller problemer.

Implementation and time schedule (revised)

Table 7: Deliverables list

Deliv-erable No	Deliverable title	Delive-ry date	Meet-ing	Nature
	WP1			
D1-4	Annual Reports for 2001-2004	Dec 2001-5		Re
D5	Materials and protocol for guided tour (public relations)	May 2002		O
D6	Report on crop yields and quality, and soil N_{min} status over 2000 – 2003 (input needed in WP3)	Jul 2004		Re
	WP2			
D7	Composted MSW and faeces for use in the field experiment each year from autumn 2001	Oct 2002 & onwards		O
D8	Report on best practice for full-scale co-composting of municipal solid waste and human faeces based on laboratory scale experiments and trials with meso-scale experiments on KVL's experimental station	Dec 2003		Re
D9	Presentation at conference	2004		
D10	Scientific manuscript on composting trials	Jul 2004		Pu
	WP3			
D11	Synthesis Report comprising the mesocosm system elements	Jun. 2003		Re
D12	Scientific manuscript on the faunal contribution to nutrient release from urban fertilizers to plants	Jun. 2004		Pu
D13	Scientific manuscript integrating faunal interactions with measured fluxes, microbial and enzyme activities	Dec. 2004		Pu
D14	Scientific manuscript on quality relationships and nutrient release patterns	Dec. 2004		Pu
D15	Popular presentation	2004		O
D16	Presentation at conference	2004		Oral
D17	Scientific manuscript on temperature relationships (3-12 °C) on nutrient release	Apr. 2005		Pu
D18	Scientific manuscript on model interpretation and field trial validation	Oct. 2005		Pu
	WP4			
D19	Popular presentation	2004		O
D20	Presentation at conference	2004		Oral
D21	International scientific paper	2005		Pub
	WP5			
D22	Report on soil characteristics, and motivated recommendation for the lay-out of the field trials	Mar. 2002		Re
D23	Popular presentation	2004		O
D24	Presentation at conference	2004		Oral
D25	Report on urban fertiliser impact on soil quality	Jun. 2005		Re