Danish Research Centre for Organic Farming

Midterm Status Report 2003 and Application for Continuation in 2004

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

CRUCIAL – Closing the Rural Urban Nutrient Cycle (III.3)

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3. Head of project

Jakob Magid, Department of Agricultural Sciences - KVL

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4. Participating institutes

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

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5. Other project staff

KVL	Jacob Møller , Lasse Dam Rasmussen, Jesper Luxhøi, Lars Stoumann Jensen,
DMU	Paul Henning Krogh, Thomas Larsen
DJF-Foulum	Gitte Rubæk, Bent T. Christensen,

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6. Project period (month, year)

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

7. Midterm description of the project, its results and progress, and application for continuation in 2004

A. Project summary

The original purpose with the project was and remains 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. By examining urban fertiliser pre-treatment, turnover in soil and impact on crop growth, the project should 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. Finally project should provide at concrete platform for the public debate, and possibilities for the public to visit the field trials.

Based on discussions with DARCOF it was agreed to refocus the efforts in CRUCIAL. This was partly in lieu of the awarded EU-Life grant (Short-Circuit), that allows further development of the composting facility into an On farm 'High temperature – Low emission – Low cost' composting system that can be operated at farm level and at the same time comply with the upcoming EU regulation on the use of waste products in agriculture. This grant was awarded on the basis of co-funding provided by the ongoing CRUCIAL project, why a readjustment of the CRUCIAL project in order allow a more comprehensive effort on composting practices for urban waste was appropriate.

Apart from a stronger focus on documentation of disease vector reduction, examination of the potential of the composting process to reduce or eliminate GMO-materials is to be done.

Furthermore we have undertaken a restructuring of the field trial. According to a veterinary assessment, the single plots could be reduced in size without compromising a future use for studying disease transfer from urban fertilizers to grazing animals. Apart from a reduction in the size as well as the long-term cost of the experiment, a key benefit in this change is a reduction in the spatial variability of soil properties and harvestable yield

Sewage sludge and municipal waste compost have been added in normal rates as well as accelerated rates, in order to rapidly approach the ecotoxicological soil quality limits for some heavy metals. This allows within a reasonable timeframe the testing of the hypothesis that using urban fertilizers will not compromise key biological capabilities of the soil system as long as established ecotoxicological soil quality limits for heavy metals are respected.

Finally the modeling effort will be strengthened to include an extrapolation of the CRUCIAL results to more sandy soil and wetter climate found elsewhere in the country. Sander Bruun, who is a key scientist in both the Biomod project will be be employed by CRUCIAL for 6 months during 2004-2005 in order to do this.

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

WP no.	Work package title	participants	Revised budget	Start	End	Deliverable No:
1	Establishment and running of Long-term field trials with urban fertilisers	KVL	727	2001	2006	1-7
2	Development of composting practises for food waste and human faeces	FSL, KVL	2055	2001	2005	8-13
3	C and N dynamics of urban fertilisers	KVL, DMU	1673	2002	2005	14-18
4	Agronomic research on P 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	323	2001	2005	22-25

B. Objectives and expected achievements

WP's	Objectives	
1	1	To provide the field-scale facility for assessing the feasibility of improved recycling of nutrients from urban areas to organic farms
1	2	To facilitate the process of sustainable urban development, by providing a platform for public debate
2	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, and nitrogen loss.
2	4	To develop a 'High temperature – Low emmision – Low cost' composting sys-tem that can be operated at farm level and at the same time comply with the upcoming EU regulation on the use of waste products in agriculture
2	4a	Examining the potential of the composting process to reduce or eliminate GMO-materials
2	4b	Examining claims that the effluent from the composting process has phyto-sanitary and other plant health promoting capabilities.
2	5	To provide sufficient amounts of composted material for the field trials in a quality that will comply with future EU-standards on agricultural use of urban waste
3	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
3	7	To provide experimental data for modeling plant nutrient dynamics of soil receiving urban fertilisers via incubation studies and the mesocosm study mentioned above
3	8	Model interpretation and extrapolation of urban fertilizers laboratory and field trial data
4	9	To assess the availability of P in urban wastes and characterize the fertilizer value of waste-derived P following introduction to arable soil
5	10	To deliver an initial characterisation of soil quality in the field experiment
5	11	To initiate a long-term monitoring of soil biological quality in the field experiment

C. Midterm results and progress

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

WP1
The field-scale facility for assessing the feasibility of improved recycling of nutrients from urban areas has been re-structured.

There has been public interest in the field experiment, as indicated by reports in national daily newspaper articles, national radio and television broadcasts, and even an international (Norwegian) radio broadcast:

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

From the Danish Public Service Radio (Program 1)
The 'Miljømagasinet' 19th april 2002, running title 'Urin kan blive fremtidens gød-

WP2
The on-farm HI-LO composting system (High temperature, low emission, low cost) is undergoing trials to demonstrate if it meets specifications. In a recent experiment feedstock was a mixture of source separated household waste, farmyard manure, and rape straw. In total, the temperature was measured at 14 different locations and logged by a computer every minute. The temperature in the middle of the compost exceeded 70 °C for a total of approx. five days. The material adjacent to the surface of the container, i.e. the coolest part, did not reach 70 °C, but even at this position a maximum temperature of 62 °C was measured and the temperature exceeded 60 °C for more than 24 hours in total. Ongoing experiments focus on increasing the temperature in the material near the surface of the container by altering the composition of the feedstock and improving the process control of the system.

Parallel with the full-scale composting, laboratory experiments were performed in the composting lab at KVL. The aim of these experiments was to study in more details the effect of mixing ratio of the feedstock on the composting process as well as the sanitation effects on pathogens and indicator organisms at different process temperatures.

Table C.1 shows the effect of mixing ratio (and subsequent C/N-ratio) on carbon- and nitrogen loss during the composting process. Nitrogen loss was smallest at a C/N-ratio of 36 and was twice as big at a C/N-ratio of 46. The presence of substantial amounts of household waste and faeces in the feedstock thus decreased nitrogen loss and demonstrated that these materials are very suitable for composting.

Table C.1. Carbon and nitrogen loss from laboratory composting system during composting of a mixture of source separated household waste, humane faeces, and rape straw

Mixing ratio of feedstock, i.e. rape straw, faeces, and organic household waste (on wet weigh basis)	C/N ratio of feedstock	C/N ratio of compost	Carbon loss (%)	Nitrogen loss (%)
9.2:1.5:1	36	23	50	21
25.6:1.5:1	43	36	44	34
83.8:1.5:1	46	37	54	42

The survival of the indicator organisms termotolerant coliforms, *Salmonella Senftenberg, Salmonella* phage 28 B, and enterococci at temperatures from 50-65 °C was investigated in conjunction with another project partially funded by Danish EPA. Curves of survival were calculated for the microorganisms as a function of exposure time at the different temperatures investigated. Based on the curves of survival, the times needed for a 4-log reduction in numbers were calculated. Similar calculations have been used in previous investigations assessing the effect of different sanitation measures. The results show that these organisms are very susceptible to heat generated by the composting process even below 70 °C. The study was performed in order to provide data for a risk assessment of use of composting toilets (Møller et al., in press). The study showed that temperatures achieved in the tested toilets did not reach thermophilic levels, sufficient to ensure complete sanitation of the feces product.

The first experiments regarding composting of gene-modified Arabidopsis have been performed, and all molecular methods involved have been adapted for this purpose. The gene modification of the Arabidopsis used in these experiments comprises a gene from Sorghum that has been introduced using the TI plasmid from *A. tumefacience*. During composting the persistence of the DNA has been followed at three different areas of the genome 1) approx. 325 bp of the transgenic DNA (cyp71E1) 2) approx. 1000 bp of the wild-type indole glucisinolate gene (cyp83B1) located on the chromosome 3) 325 bp of the 18S ribosomal DNA located in the mitochondria. Amplification of the wild-type DNA showed a very fast degradation of the chromosomal DNA. Actually, this DNA was only observed on day 0 (which was just prior of composting initiation) with the exception of one of the triplicate samples where an extremely weak band was observed until day 6. The transgenic DNA turned out to be much more persistent. PCR bands were observed in all samples from day 0 to day 10. The intensity of the bands was decreasing during the course of the experiment, but even at day 10 fairly strong bands were observed. No bands were observed in any of the triplicate samples from day 14. Whether, this was due to a complete degradation of the DNA or if further dilution of the sample due to increasing interference from humic substances is required in order for PCR to be performed, still has to be investigated. In the case of the 18S ribosomal DNA the results were exactly the same as that of the transgenic DNA. The mechanisms causing the discrepancy in the persistence of the different DNA types are currently under investigation. Furthermore the possible transfer of (transgenic) DNA to thermophilic bacteria is being investigated.

WP3

Mesocosm experiments have been performed using degassed household waste as well as composted household waste as representative urban fertilizers. Similar amounts of plant available N was added using degassed household waste (equivalent to 9 t ha^{-1}) or composted household waste (equivalent to 40 t ha^{-1}), both materials having previously been defaunated, to the upper 5 cm of soil columns that were planted with spring wheat, and grown for 4 months until maturity. The system contained an intact microbial and microfaunal community, but was initially defaunated with regard to mesofauna. The soil columns was added a model community of mesofauna consisting of representatives for fungivores, bacteriovores, herbivores and predators. There was no significant effect of adding mesofauna on plant dry matter yield (Figure 1a). However, even though more CO_2 was evolved from the soils receiving degassed household waste, indicating a higher turnover of organic matter, there

was little (and insignificant) effect of degassed waste on mesofaunal development. Addition of compost gave rise to substantial and significant increases in mesofaunal development, regardless that control experiments indicated lower turnover of organic matter (Figure 1b). This could have potential implications for the soils ability to withstand a number of pests and diseases, and will be explored in more detail during the coming 3 year PhD study sponsored by KVL, DMU and SOAR.

An experiment additional to the mesocosm trial was performed in order to assess gross mineralisation and immobilisation of the urban fertilisers, as well as the effect of defaunation of the soil. The results clearly indicate that defaunation of soil leads to a decrease in carbon respiration, and thus in organic matter turnover. Results from the gross mineralisation measurements are still incomplete, but overall the quality of data appears to be sufficient for a paper in an international journal.

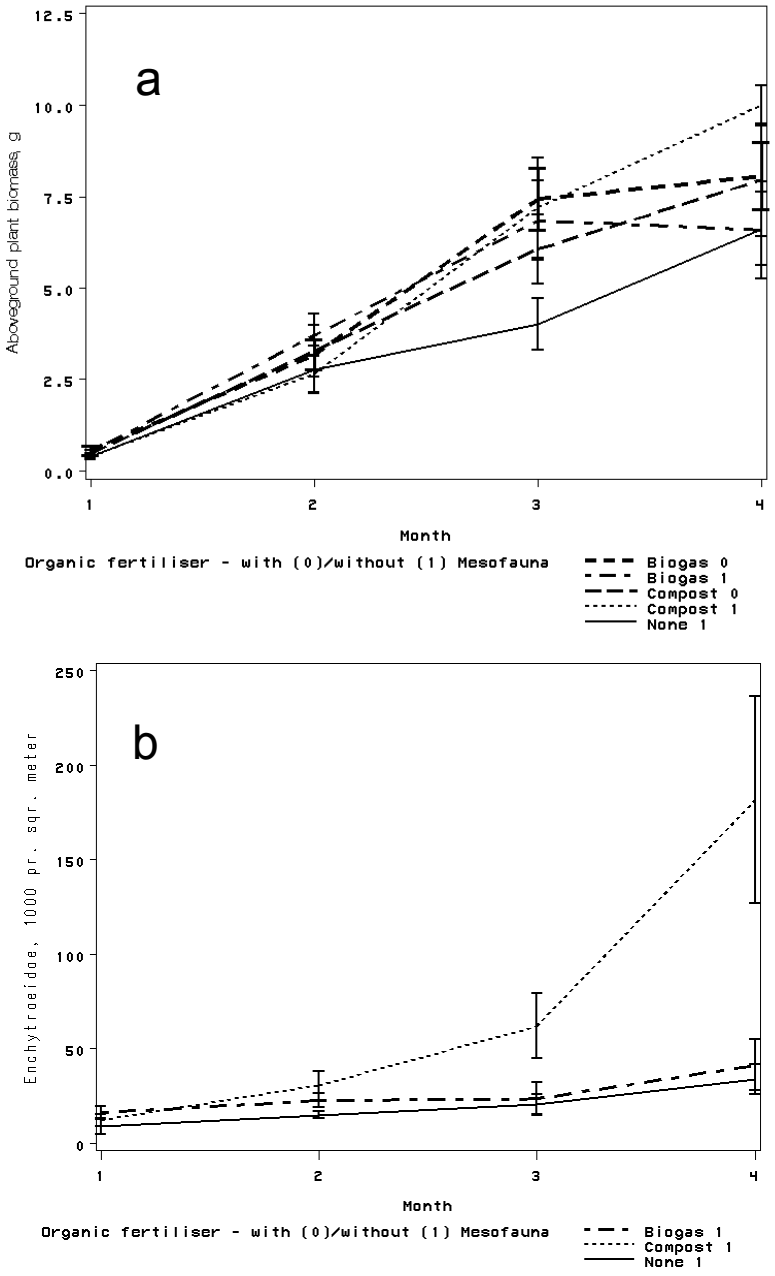

Figure 1. Plant biomass (a) and enchytraeid abundance (b) during experimental simulation of decomposition of degassed and composted household waste, termed biogas, compost with (1) or without (0) addition of a model mesofauna community.

WP4
Experiments to assess the availability of P in urban wastes and characterise the fertiliser value of waste-derived P following introduction to arable soil were initiated in spring 2003. Preliminary results of yield, resin P in soil and soil pH for the first two plant and soil sampling dates are shown show differences in responses to the manure treatments, but it is too early to draw conclusions on these results at this stage. One more sampling is scheduled this year, and sampling will continue in 2004.

WP5
The soil quality characterization of the field has been performed and delivered

Monitoring of soil biological quality in the field experiment has been initiated

C.2 Fulfilment of deliverables and milestones

WP1 Establishment and running of Long-term field trials with urban fertilisers	Time schedule	Deviations, if any*
Deliverables		
Annual reports 2001-2005	2001 – 2005	
Materials and protocol for guided tour (public relations)	May 2002	
Report on crop yields and quality, and soil N_{min} status over 2002 – 2004 (input needed in WP3)	Dec 2004	
Milestones		
Establishment of permanent grass strips	Oct. 2001	March 2002
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	

WP2 Development of composting practises for food waste and human faeces	Time schedule according to application	Deviations, if any*
Deliverables		
Composted MSW and faeces for use in the field experiment each year from autumn/winter 2002	Oct 2002 & onwards	Mar 2003 & 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	April 2003
Scientific manuscript on composting trials	Jul 2004	
Report on phyto-sanitary effects of compost effluent	Jul 2005	
Scientific manuscript on GMO materials in compost	Jul 2005	

Establishment of a composting facility at KVL's experimental station	Apr. 2002	Sep 2002
Milestones		
First meso-scale composting trial completed (to be repeated each year)	Oct. 2002	Dec 2002
Laboratory studies on composting completed	July 2004	
Laboratory studies on GMO material in compost completed	Dec. 2004	
Trials with compost effluent completed	Dec. 2004	

WP3 C and N dynamics of urban fertilisers	Time schedule according to application	Deviations, if any*
Deliverables		
Contributions to status and final project reports	Oct 2002 & onwards	
Synthesis report comprising the mesocosm system elements	Dec 2003	
Popular presentation	2004	
Four scientific papers		
Milestones		
Comprehensive mesocosm study completed	Dec. 2003	
Further incubation studies on quality and temperature effects on temporal patterns of nutrient fluxes completed	July 2004	
Model interpretation of relevant parts of the aforementioned milestones	Dec. 2004	
Simulation completed of the field trials based on parameterisation of urban fertilisers, climate data and relevant crop modules and concomitant testing of the predictive capability based on data from the field (WP1)	July 2004	

WP4 C and N dynamics of urban fertilisers	Time schedule according to application	Deviations, if any*
Deliverables		
Contributions to status and final project reports	Oct 2003 & onwards	
Popular presentation	2004	
Presentation at conference	2004	
International scientific paper	2005	
Milestones		
Characterization of waste completed	2004	
Pot experiment completed	2004	
Analyses of soil from field experiment (WP1) completed	2004	
Final report submitted	Dec. 2005	

WP5 Soil quality monitoring programme	Time schedule according to application	Deviations, if any*
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	Oct 2002
Report on urban fertiliser impact on soil quality	2004	Can not be delivered
Milestones		
Establishment of soil archive	Sep. 2001	
Layout of plots	Oct. 2001	March 2002 revised Dec. 2002
Sampling of plots for faunal and other biological characterisation (soil quality baseline study)	Oct. 2002	
Completed baseline study	Mar. 2003	Can not be delivered
Sampling of plots for faunal and other biological characterisation	Aug. 2004	Can not be delivered
Completed soil quality impact study after 3 years of treatment/fertilisation	Oct. 2005	Can not be delivered

** Deviations are to be further discussed in D*

D. Description of deviations and subsequent adjustments of plans

WP1 and 2
It has turned out to be more difficult than foreseen to establish a fully functioning on farm meso-scale composting reactor (HI-LO) system. This was only managed in the spring of 2003. Therefore the deliveries to the CRUCIAL field trials have this year been based on composted municipal waste from an outside source (Klintholm-IS).

WP5
It was decided to make a reduction of the budget regarding the monitoring of soil biological and biochemical properties. This was done based on the projects own assessment that substantial effects on these parameters might take longer time to emerge. Therefore some of the foreseen deliveries from this work package cannot be realized within the current project.

E. Project publications and other products

1. Articles in international, scientific journals with review procedures

Færge, J., Magid, J. and de Vries, F. P. (2001) Urban Nutrient Balance Modelling for Bangkok. *Ecological Modelling,* **139, 63-74

2. Papers presented at congresses, symposiums, etc.

A national workshop on 'Composting Plant Residues and Human Waste in support of High Value Organic Plant Production' was organised by the CRUCIAL project on 28th February 2002 at KVL.

* Møller, J., Backlund, A., Jørgensen L.T., Forslund, A., and A. Dalsgaard. Survival of indicator organisms and pathogens in compost toilets and by simulated centralised composting of humane faeces. Environmental project by the Danish EPA (in press). In Danish with an English summary.

** Magid J., Granstedt A., Dýrmundsson Ó., Kahiluoto H. and Ruissen T. (Eds.) 2002. Urban Areas – Rural Areas and Recycling. -The organic way forward? Proceedings from NJF-seminar No. 303. Copenhagen, Denmark, 20-21 August 2001. DARCOF report no. 3. 2002. pp. 190.

Magid J. (2002) Hard and soft science issues to be negotiated to improve urban metabolism. In 'Urban areas – Rural areas, and recycling – the organic way forward?'. Eds. Jakob Magid, A. Granstedt, Ó Dýrmundsson, H Kahiluoto, T Ruissen, Darcof report no. 3, pp. 105-116

** Reeh U. and Møller J. (2002) Evaluation of different biological waste treatment strategies. In 'Urban areas – Rural areas, and recycling – the organic way forward?'. Eds. Jakob Magid, A. Granstedt, Ó Dýrmundsson, H Kahiluoto, T Ruissen, Darcof report no. 3, pp. 147-156

** Holmqvist, A., Møller, J., and A. Dalsgaard. 2003. Latrine composting - a hygienic evaluation. Poster and abstract at ECOSAN the 2nd International Symposium on ecological sanitation, April 7-11, 2003 Lübeck, Germany.

** Møller, J., Forslund, A., and A. Dalsgaard. 2003. Reduction of faecal microbial indicators in different compost toilets. Poster and abstract at ECOSAN the 2nd International Symposium on ecological sanitation, April 7-11, 2003 Lübeck, Germany.

Magid J. (2002) Byernes affaldshåndtering og næringsstofkredsløb. Chapter 10. In: 'Visioner for Fremtidens Jordbrug'. Eds. E.S. Jensen, H. Vejre, S. Højbjerg Bügel and J. Emanuelsson, Gads Forlag, København, 181-202

3. Reports, articles in agricultural journals, etc.
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. Oral presentations, public meetings, field days, etc.

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

Magid J. (2003) Closing the Rural Urban Nutrient Cycle – Services from Peri-Urban Agriculture in Containing and Managing Risk from Urban Metabolism. Invited speaker at Bertebos conference 'Ecosystem services in European agriculture: Theory and practice', 14-16 September, 2003, Falkenberg, Sweden

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

Presentations for 3 high-school groups on separate occasions in february- april 2002, Jakob Magid, KVL

Presentations for 4 high-school groups on separate occasions in november- December 2002, Jakob Magid, KVL

Presentations for 3 high-school groups on separate occasions in february – april 2003, Jakob Magid, KVL

F. Scientific education

A European Science Foundation LinkEcol grant supported visting scientist, Dr Michaël Coeurdassier. He has conducted a study to evaluate the quantitative effects of decreasing the diversity, using pesticides as a tool, on the foodweb structure of the soil communities (particularly microarthropods, earthworms and bacteria) and the possible consequences of community structure modifications on soil functions, i.e. decomposition of cow dung and N cycling.

Thomas Larsen will be employed by October 1st 2003, to undertake a 3 year PhD program entitled 'Soil Ecological Modelling of Urban Fertilizer Turnover'. This is funded jointly by KVL-DMU and SOAR

G. National and international cooperation

The CRUCIAL project is part of a portfolio hosted by:

NUTRAP
CENTRE FOR APPROPRIATE TECHNOLOGIES FOR NUTRIENT RECYCLING FROM HUMAN WASTE TO AGRICULTURE IN PERI-URBAN AREAS

A number of research departments have signed the MOU and take part in its activities. For further information on NUTRAP please refer to: www.agsci.kvl.dk/nutrap

Via the EU-Life funded activity, of which CRUCIAL is an integral part, a collaboration has been developed with:

The Department for Industrial Ecology, Royal Technical University (KTH), Stockholm, Sweden

Aarstiderne A/S

Krogerup Avlsgaard A/S

Dansk Jordforbedring, SOLUM Gruppen A/S

Furthermore international collaboration has emerged in three areas:

The project leader of CRUCIAL has delivered input to an integrated waste management plan for Kuching (Sarawak state, Malaysian Borneo). The Sarawak government has recently decided that ecological sanitation will be the main pillar of the waste management, and that conventional sanitation will be used only in the central business district. Upon successful implementation of pilot scale projects for some housing and institutional areas, the state has decided to enlarge an ecological sanitation scheme to 250.000 people in the first instance. Jakob Magid has been asked to provide further input into this process, by Kuching's Sustainable Urban Development Project.

The Environmental Engineering Group, Swedish University of Agricultural Sciences, Proffesor Håkan Jönsson and co-workers

Institute of Plant Science, the Group Plant Nutrition at ETH in Zurich (Prof. Emmanuel Frossard). Collaboration on advanced analyses regarding P is presently being planned and will be carried out during a stay at ETH by Senior Scientist Gitte Rubæk in 2004

H. Critical reflection on the project

WP1. In connection with the restructuring of the field experiments some changes have been made which together with the emergent need for mechanical weed control raises some questions about the crop rotation. Originally it was decided to use urban fertilizers, such as sewage sludge and municipal waste compost with a moderate or low content of available nitrogen as P (and K) fertilizers, and include as much green manure (N-fixing) between cash crops as possible. In connection with the 2002 status report, and the ensuing discussions with DARCOF, it was however very clearly signaled that there was little interest in supporting very long-term field experiments. Therefore 'normal' rates of sludge and MSW compost are calculated on the basis of N content, and additionally accelerated rates have been included. This allows within a shorter timeframe the testing of the hypothesis that using urban fertilizers will not compromise key biological capabilities of the soil system as long as established ecotoxicological soil quality limits for heavy metals are respected. We need to reconsider the crop rotation in the light of this change and the needs for weed control. This will be done in the coming months, and we would like to consult with Jørgen Olesen and others who are responsible for other long-term field experiments.

From the outset the CRUCIAL project was conceptualized as a visionary or futuristic project, since it was realized that changing urban metabolism is bound to be a very long-term venture. Since then the political winds have changed, and are currently less in favor of arguments based on ecology /environment and nature *per se*, and much more focused on somewhat narrow cost-benefit analysis. This does not mean that the concepts developed by CRUCIAL cannot be utilized, but it does present an additional challenge to a successful dissemination of results. Currently the project leader is focusing on documenting the economics in the urban ecology village Munksøgaard, in collaboration with the inhabitants and colleagues from the Danish Technical University. We are also in the process of designing an 'open university course' on 'Urban ecology and living spaces' to be offered to undergraduates, 'in-service' professionals and ordinary citizens. The hope is that this will be able to stimulate a constructive dialogue and provide a useful input in favor of sustainable urban ecological development. From the outset, it was also stressed that some of the more immediate benefits of this work would possibly be reaped in developing countries that have little waste management infrastructure in place, but are undergoing an economic and social development process that makes this much more urgent than in our part of the world. This seems to be confirmed by actual events taking place, where there is demand for our knowledge input in relation to ecological sanitation projects in both Ghana (Accra) and Sarawak (Kuching, Bornean Malaysia).

In order to further development of Danish ecological urban waste management at a scale where Danish organic farmers can benefit and play a role we propose to work towards creating a dialogue between relevant stakeholders, that could eventually lead to 1) progressive municipal authorities endorsing the eco-sanitation concept by integrating it into development plans for specific (new) housing areas, and 2) development of functionally adequate treatment practices for municipal sorted waste (perhaps 'on-farm'). The second development objective is central to the EU-Life project 'Short-Circuit'.

WP2. We have found that the sludge from the eco-village Munksøgaard is so dilute,

that a composting of this as a representation of fecal material is not feasible. We suggest that the fecal composting experiments (with raw feces) is limited to laboratory trials and focused on disease vectors and compost quality in general. Furthermore that the meso-scale (HI-LO) system be tested with de-watered sewage sludge in combination with municipal sorted waste and some suitable structural material. This is a representation of actually abundant urban waste, where a composting would be expected to improve its fertilizer quality with regard to disease vectors and presence of undesirable organic substances (xenobiotics).

For the future applications of composted municipal waste in the field experiment (WP1) we wish to use compost from the AIKAN plant, which is in line with the EU-life project that is co-funding the activities. We cannot obtain enough raw feces material to make a larger composting, and we already have sewage sludge represented in the field trial, therefore it is more revealing to look at the impact of a 'sewage free' compost of municipal waste.

Regarding the currently developing research on survival of transgenic DNA during composting and its potential transfer to thermophilic bacteria that are competent in taking up DNA, this could turn out to have implications for standard risk assessment practices on GMO. In that case it should be discussed in a wider forum, and it would be relevant for DARCOF to play a role.

WP3. The joint DMU-KVL experiments on decomposition of urban fertilizers and their impact on the soil food web have besides revealing interesting scientific data highlighted the differences in tradition and methodological approaches developed in soil organism oriented vs. soil-plant atmosphere flux oriented scientific communities. It is very fortunate that it has been possible (as of October 2003) to establish a joint DMU-KVL-SOAR funded Ph.D. project to further bridge these knowledge bodies. During this work it has become clear that there is a need to underpin the broader concept of soil fertility better, and that the relationship between energy turnover in soil and its impact on higher levels of the soil food web's potential control plant pests is becoming very topical. This has been discussed in the Plant Nutrition and Soil Fertility Laboratory at KVL, and there is an acceptance that we should try to stimulate research in this broad fertility concept in collaboration with soil ecology research groups.

8. Budget

A. Account for any change in budgets

For DJF's contribution (Institution 3, WP4) we kindly request that funding for wage for scientific personnel corresponding to DKr 40000 and operational costs for DKr. 20000 are transferred from 2003 to the 2004 budget

Reasons for these adjustments are:

1. All dried samples are compiled for analyses in 2004.
2. Advanced analyses and visit at ETH in Zurich are scheduled for 2004

B. Budget for the whole project (1.000 DKK)

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

Year	Consump-tion before 2003	Expected consump-tion 2003	2004	2005	2006	Total
Man-months						
Scientific personnel	21.8	21.5	19.6	13.4	1.5	78
Technical personnel	0.8	5.3	5.4	2.9	1.2	16

Year	Consump-tion before 2003	Expected consump-tion 2003	2004	2005	2006	Total
Salaries						
Salary (coordination)	30	20	50	50	40	190
Scientific personnel	804	616	769	431	0	2620
Technical personnel	20	131	134	70	30	385
Other operational costs	149	123	129	81	40	522
Transport af 'By-gødninger'	31	33	33	34	35	166
Special field operations	45	35	35	35	20	170
Composting facility and equipment	125	80				205
Characterisation of the experimental field	110	0				110
Direct costs	1314	1038	1150	701	165	4368
Indirect costs (20% of direct costs)	263	208	230	140	33	874
Total	1576	1246	1380	841	198	5241

9. Signatures and stamps

Name	Institute	Date	Signature
Jakob Magid	Agricultural Sciences, KVL	30th September 2003	

Appendix I. Detailed Budget

A. Budget for each participating institute

Institution 1 (KVL)	2001	2002	2003	2004	2005	2006	Total
Salary (coordination)	0,5	0,3	0,5	1,0	1,0	1,5	4,9
Scientific personnel	2,3	9,8	6,4	13,3	9,2	0,0	41,0
Technical personnel	0,0	0,8	2,9	2,9	2,9	1,2	10,6

Institution 1 (KVL)	2001	2002	2003	2004	2005	2006	Total
Salaries							
Salary (coordination)	20	10	20	50	50	40	190
Scientific personnel	80	337	220	460	316		1413
Technical personnel	0	20	70	70	70	30	260
Other operational costs	22	70	70	70	70	40	342
Transport af 'By-gødninger'		31	33	33	34	35	166
Special field operations		45	35	35	35	20	170
Composting facility and equipment		125	80				205
Characterisation of the experimental field		110					110
Direct costs	122	748	528	718	575	165	2856
Indirect costs (20% of direct costs)	24,4	149,6	105,6	143,6	115	33	571
Total	146	898	634	862	690	198	3427

Institution 2 (DMU)	2001	2002	2003	2004	2005	2006	Total
Scientific personnel	0	6	6	4	3		19
Technical personnel	0	0	0	0			0

Institution 2 (DMU)	2001	2002	2003	2004	2005	2006	Total
Scientific personnel		201	216	159	115		691
Technical personnel							0
Other operational costs		27	19	19	11		76
Direct costs		228	235	178	126		767
Indirect costs (20% of direct costs)		46	47	36	25		153
Total		274	282	214	151		920

Institution 3 DJF Foulum	2001	2002	2003	2004	2005	2006	Total
Scientific personnel			1.7	4.3			6.0
Technical personnel			2.4	2.6			5.0

Institution 3 DJF Foulum	2001	2002	2003	2004	2005	2006	Total
Scientific personnel			60	150			210
Technical personnel			61	64			125
Other operational costs			10	40			50
Direct costs			131	254			385
Indirect costs (20% of direct costs)			26	51			77
Total			157	305			462

Institution 4 FSL	2001	2002	2003	2004	2005	2006	Total
Scientific personnel		3	3				6
Technical personnel							

Institution 4 FSL	2001	2002	2003	2004	2005	2006	Total
Scientific personnel	75,7	110	120				306
Other operational costs	15	15	24				54
Direct costs	91	125	144				360
Indirect costs (20% of direct costs)	18	25	29				72
Total	109	150	173				432

B. Budget for each participating department (1.000 DKK)

See above under A. Budget for each participating Institute

C. 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:

Implementation and time schedule (revised)

Table 7: Deliverables list

Deliv-erable No	Deliverable title	Delive-ry date	Meet-ing	Nature
	WP1			
D1-5	Annual Reports for 2001-2005	Dec 2001-5		Re
D6	Materials and protocol for guided tour (public relations)	May 2002		O
D7	Report on crop yields and quality, and soil N_{min} status over 2002 – 2004 (input needed in WP3)	Dec 2004		Re
	WP2			
D8	Composted MSW and faeces for use in the field experiment each year from autumn 2001	Oct 2002 & onwards		O
D9	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
D10	Presentation at conference	2004		
D11	Scientific manuscript on lab scale composting trials	Jul 2004		Pu
D12	Report on phyto-sanitary effects of compost effluent	Jul 2005		Re
D13	Scientific manuscript on GMO materials in compost	Jul 2005		Pu
	WP3			
D14	Synthesis Report comprising the mesocosm system elements	Aug. 2003		Re
D15	Scientific manuscript on the faunal contribution to nutrient release from urban fertilizers to plants	Jun. 2004		Pu
D16	Scientific manuscript integrating faunal interactions with measured fluxes, microbial and enzyme activities	Dec. 2004		Pu
D17	Scientific manuscript on quality relationships and nutrient release patterns	Dec. 2004		Pu
D18	Popular presentation	2004		O
D19	Presentation at conference	2004		Oral
D20	Scientific manuscript on model interpretation and field trial validation	Oct. 2005		Pu
	WP4			
D21	Popular presentation	2004		O
D22	Presentation at conference	2004		Oral
D23	International scientific paper	2005		Pub
	WP5			
D24	Report on soil characteristics, and motivated recommendation for the lay-out of the field trials	Mar. 2002		Re
D25	Popular presentation	2004		O
D26	Presentation at conference	2004		Oral
D27	Report on urban fertiliser impact on soil quality	Jun. 2005		Re