MINISTERIET FOR FAMILIE- OG FORBRUGERANLIGGENDER

Ministeriet for Fødevarer, Landbrug og Fiskeri
Direktoratet for FødevareErhverv

Danish Research Centre for Organic Farming

Application

for research funding under the research programme:

Research in Organic Food and Farming

International Research Co-operation and Organic Integrity

(DARCOF III 2005-2011)

Funded by the Ministry of Food, Agriculture and Fisheries
under the Finance and Appropriation Act, Sections 24.33.02.10

1. Project title and acronym (acronym max. 10 letters):

AGronomical and TEChnological methods to improve ORGanic wheat quality (AGTEC-Org)

2. Danish coordinator. For projects with more than one participating Danish institute a coordinator should be appointed to coordinate the project. (name, title, institute, address, telephone, fax and e-mail):

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3. The project is within the following research topic of the CORE Organic Pilot Call:

☐ Animal

X Quality

☐ Marketing

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4. Participating Danish institute(s):

	Name	Contact person/e-mail
1.	Department of Agroecology and Environment, Faculty of Agricultural Sciences, University of Aarhus, Blichers Allé 20, P.O. Box 50, DK-8830 Tjele, Denmark	Ingrid K. Thomsen ingrid.thomsen@agrsci.dk
2.		
3.		
4.		
5.		
6.		

Annex 1 should be completed for <u>each</u> participating Danish institute.

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5. Project duration:

From: May 2007

To: December 2010

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6. Main objective(s) for the entire project (maximum 10 lines):

The overall objective of this project is to identify agronomical and food processing technologies that enhance the baking quality and the nutritional value of organic wheat and reduce mycotoxin contamination. Specific objectives are to:

- Evaluate the current practices for organic grain wheat production and flour-processing in Europe.
- Improve crop management strategies to enable bread-quality wheat to be produced on organic farms with and without livestock.
- Develop optimal post-harvest treatment to prevent mycotoxin contamination and enhance bread making quality and nutritional value.
- To generalise results from experiments in order to enhance farm management strategies in other climates and soil types.

7. Project summary for the entire project in Danish (approximately 1 page, suitable for publication):

Forbrugere af økologisk brød og mel forventer høj kvalitet både mht. indhold af næringsstoffer og mht. fødevaresikkerhed. Økologiske landmænd har imidlertid ikke så mange muligheder for at justere næringsstoftilførsel og bekæmpelse af ukrudt og plantesygdomme som konventionelle avlere, men må i højere grad basere produktionen på et godt kendskab til betydning af bl.a. sædskifteforhold og de grundlæggende processer i jorden. Efter høst vil behandlingen og den videre formaling påvirke melets renhed og finhed, hvilket har betydning både ernærings- og smagsmæssigt.

Dette fælleseuropæiske projekt har som formål at optimere produktion af brødhvede fra jord-til-bord. Under produktionen af brødhvede vil dyrkningsmæssige tiltag i form af anvendelse af forskellige typer efterafgrøder, jordbearbejdningsstrategier, gødningshåndtering og samdyrkning af hvede og bælgplanter blive taget i anvendelse med henblik på at øge mængden af næringsstoffer og optimere synkroniseringen mellem næringsstoffrigivelse og planteoptag. Disse undersøgelser vil for en stor del finde sted i de langvarige, økologiske forsøg, der gennemføres i Europa.

Kerneprøver fra de forskellige forsøg vil blive indsamlet og analyseret mht. infektion af mykotoksin, og udvalgte prøver vil gennemløbe behandling med ozon eller varme før formaling. Formaling af kernerne vil ske på to forskellige metoder med varierende tilbageholdelse af skaldele, og melet blive anvendt til undersøgelser vedr. bageegenskaber og indhold af næringsstoffer.

Ud fra undersøgelserne vedr. dyrkning og bagekvalitet vil det blive klarlagt, hvilke produktionsmæssige tiltag der vil kunne bringes i anvendelse til optimering af brødhvedeproduktionen i Europa. I en syntese vil de miljømæssige og økonomiske konsekvenser af disse tiltag efterfølgende blive evalueret vha. modelberegninger. Resultaterne vil blive publiceret nationalt og internationalt.

8. **Budget** (note that budget should be made for the entire Danish part of the project (below) as well as for each participating Danish institute (annex 1)):

Budget for the entire Danish part of the project

Budget line		**1. calendar year**		**2. calendar year**		**3. calendar year**		**4. calendar year**		**Total**	
		Months	DKK	Months	DKK	Months	DKK	Months	DKK	Months	DKK
Project in total	Salaries/academic staff	1.30	63,260	3.80	189,130	5.30	281,980	4.30	231,360	14.70	765,730
	Salaries/ techn.-adm. Staff	1.21	34,250	3.60	106,660	3.86	118,900	1.71	54,890	10.38	314,700
	Equipment over 40.000 kr.		0		0		0		0		0
	Operating costs		50,300		167,400		122,400		0		340,100
	Others (please specify below)		76,200		104,200		104,800		44,300		329,500
	General expenses (20%)		44,802		113,478		125,616		66,110		350,006
	Total		268,812		680,868		753,696		396,660		2,100,036

Budget line		**1. calendar year**		**2. calendar year**		**3. calendar year**		**4. calendar year**		**Total**	
		Months	DKK	Months	DKK	Months	DKK	Months	DKK	Months	DKK
Work package 1	Salaries/academic staff									0	0
	Salaries/ techn.-adm. Staff									0	0
	Equipment over 40.000 kr.										0
	Operating costs										0
	Others (please specify below)										0
	General expenses (20%)										0
	Total		**0**		**0**		**0**		**0**		**0**

	Budget line	1. calendar year		2. calendar year		3. calendar year		4. calendar year		Total	
		Months	DKK	Months	DKK	Months	DKK	Months	DKK	Months	DKK
Work package 2	Salaries/academic staff									0	0
	Salaries/ techn.-adm. Staff									0	0
	Equipment over 40.000 kr.										0
	Operating costs										0
	Others (please specify below)										0
	General expenses (20%)										0
	Total		**0**		**0**		**0**		**0**		**0**

	Budget line	1. calendar year		2. calendar year		3. calendar year		4. calendar year		Total	
		Months	DKK	Months	DKK	Months	DKK	Months	DKK	Months	DKK
Work package 3	Salaries/academic staff									0	0
	Salaries/ techn.-adm. Staff									0	0
	Equipment over 40.000 kr.										0
	Operating costs										0
	Others (please specify below)										0
	General expenses (20%)										0
	Total		**0**		**0**		**0**		**0**		**0**

Budget line		1. calendar year		2. calendar year		3. calendar year		4. calendar year		Total	
		Months	DKK	Months	DKK	Months	DKK	Months	DKK	Months	DKK
Work package 4	Salaries/academic staff									0	0
	Salaries/ techn.-adm. Staff									0	0
	Equipment over 40.000 kr.										0
	Operating costs										0
	Others (please specify below)										0
	General expenses (20%)										0
	Total		**0**		**0**		**0**		**0**		**0**

Budget line		1. calendar year		2. calendar year		3. calendar year		4. calendar year		Total	
		Months	DKK	Months	DKK	Months	DKK	Months	DKK	Months	DKK
Work package 5	Salaries/academic staff									0	0
	Salaries/ techn.-adm. Staff									0	0
	Equipment over 40.000 kr.										0
	Operating costs										0
	Others (please specify below)										0
	General expenses (20%)										0
	Total		**0**		**0**		**0**		**0**		**0**

Budget line		**1. calendar year**		**2. calendar year**		**3. calendar year**		**4. calendar year**		**Total**	
		Months	DKK	Months	DKK	Months	DKK	Months	DKK	Months	DKK
Work package 6	Salaries/academic staff									0	0
	Salaries/ techn.-adm. Staff									0	0
	Equipment over 40.000 kr.										0
	Operating costs										0
	Others (please specify below)										0
	General expenses (20%)										0
	Total		**0**		**0**		**0**		**0**		**0**

Budget line		**1. calendar year**		**2. calendar year**		**3. calendar year**		**4. calendar year**		**Total**	
		Months	DKK	Months	DKK	Months	DKK	Months	DKK	Months	DKK
Work package 7	Salaries/academic staff									0	0
	Salaries/ techn.-adm. Staff									0	0
	Equipment over 40.000 kr.										0
	Operating costs										0
	Others (please specify below)										0
	General expenses (20%)										0
	Total		**0**		**0**		**0**		**0**		**0**

Budget line		1. calendar year		2. calendar year		3. calendar year		4. calendar year		Total	
		Months	DKK	Months	DKK	Months	DKK	Months	DKK	Months	DKK
Work package 8	Salaries/academic staff									0	0
	Salaries/ techn.-adm. Staff									0	0
	Equipment over 40.000 kr.										0
	Operating costs										0
	Others (please specify below)										0
	General expenses (20%)										0
	Total		**0**		**0**		**0**		**0**		**0**

Financing of the entire Danish part of the project

Budget line		From Ministry of Food, Agriculture and Fisheries		From work place		From other sources		Total	
		Months	DKK	Months	DKK	Months	DKK	Months	DKK
Entire project	Salaries/academic staff	14.70	765,730		0			14.70	765,730
	Salaries/ techn.-adm. Staff	10.38	314,700		0			10.38	314,700
	Equipment over 40.000 kr.		0		0				0
	Operating costs		340,100		145,565				485,665
	Others (please specify below)		329,500		0				329,500
	General expenses (20%)		350,006		385,482				735,488
	Total		2,100,036		531,047		**0**		2,631,083

Comments to the budget including specification of the budget line ”Others”:

The budget line “Others” covers field experiments and coordination expenses.

9. Mile stone table for the Danish part of the project

Each mile stone should be accompanied with a short text concerning the activity it relates to.

Activity (with mile stone number)	**2007**				**2008**				**2009**				**2010**			
Quarterly	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**
1. Project meeting with preparation of annual and final reports			X				X				X					
2. Wheat grain from the Organic Farming Crop Rotation ready for analyses				X				X				X				
3. Field data ready for supporting decision-making tools and models								X				X				
4. Soil-crop modelling and environmental assessment completed.																X
5. Economic assessment completed.																X

10. List of deliverables from the Danish part of the project to CORE Organic Pilot Call

Deliverable No.	Deliverable title	Lead scientist	Delivery date	Allocated scientific person moth	Type of deliverable
1	Mycotoxin infestation as influenced by farming system	IKT	2010	2	C
2	Wheat grain quality as influenced by agronomic practices	IKT	2010	2	P
3	International paper on the influence of fertilization, green manure and soil type on grain quality	IKT	Sep 2010	4	S
4	Environmental and economic assessment of improving crop rotations and crop management practises	JEO	2010	1	C
5	International paper on evaluation of environmental and economic assessment of improving crop rotations and crop management practises	JEO	Dec 2010	2	S
6	Contributions to website, annual reports, joint papers etc.	IKT	200x	4	O

(The nature of the deliverables must be indicated by S = publication in scientific journal with peer review; P = publication in journals without peer review; R = reports; C = presentation at meetings and congresses or O = other types of deliverables, e.g. prototypes, model, websites, etc.)

IKT: Ingrid K. Thomsen
JEO: Jørgen E. Olesen

11. Annex 1 - Information and budget for each participating institute

12. Annex 2 - Original application

AGronomical and TEChnological methods to improve ORGanic wheat quality (AGTEC-Org)

State of the art

The main challenge to organic farmers, millers and bakeries is to fulfil consumer expectations of providing healthy and safe products without impairing yield. The quality of organic grain can be modified by agronomic conditions such as crop management, crop rotation and soil fertility (Mäder et al 2002), but the post-harvest handling of grain and the flour processing are also key factors in producing bread of high nutritional value without contaminants. This project focuses on the optimization of agronomic practices and grain fractionation processes in order to obtain wheat and flour with improved nutritional value, health and sensory characteristics.

Nitrogen (N) is a key nutrient in achieving acceptable yield levels of sufficient bread-making quality, but previous results have shown that organic wheat tends to have lower protein content, dough mixing tolerance and loaf volume (David et al 2005a). Other studies show no reduction in protein concentration, amino acid composition and baking quality, despite a 71% lower addition of plantavailable N (Mäder et al 2006). Organic cereal crops rely on N mineralized from organic matter in the soil including residues from previously incorporated crops and manures, and to improve the overall N use efficiency of a wheat crop, synchrony between N demand of the growing crop and N mineralization should be optimized (David et al 2005b; Friedel et al 2001). On livestock farms, N in animal manure may be supplied directly to crops. Both the total amounts of manure supplied and its previous handling (e.g. with and without composting) may be very important for the timing of N availability in the field. In systems without livestock, an on-farm fertilizer production, such as from the anaerobic digestion of crop residues or organic fertilizers, may deliver substantial amounts of N for crop growth. Soil N availability may also be modified by adjusting soil tillage operations in either time or space. By adjusting the time of ploughing (autumn/spring), synchronization between N mineralization and crop N demand may be improved. N mineralization may likewise be adjusted by changing depth and intensity of soil tillage operations, using, e.g. reduced tillage (Peigné et al 2006).

To increase the amount of plant-available N, more soil N must be conserved in breaks between main crops or soil N input must increase. The use of catch crops is very efficient at reducing nitrate leaching (Thomsen and Christensen 1999) and the N retained in soil will successively become available for crop N uptake (Thomsen and Christensen 2004). By introducing legumes, soil N levels may likewise increase and raise soil mineralization capacity. Legumes may either be grown in breaks or by co-cropping with the main crop (Hiltbrunner et al 2005b). Previous results have shown that intercropping of legumes and cereals is a promising technology in low-input farming systems thanks to a better use of N sources (soil N and N_2 fixation), an increase of yield and stability, a reduction of weed infestation (Hiltbrunner et al 2005a) and a large increase in cereal protein content compared with a monoculture (Corre-Hellou et al 2006; Jensen et al 2006; Kasyanova et al 2006; Thorsted et al 2006). However, balancing the relative yield loss with quality remains a challenge, which requires further investigations of the management and the economic value of the intercropped cereal (especially through N fertilization and plant density).

Irrespective of farming system, the presence of mycotoxins, especially deoxynivalenol (DON), is of major concern for grain growers (Köpke et al 2006). The degree of contamination from *Fusarium spp*. is affected by agronomic factors such as crop rotation, soil tillage, nutrient input and weed control (Berner et al 2005). Since the fungal growth is concentrated in the hull, the flour processing methods that remove different outer layers of the grain may likely influence the degree of contamination. Physico-chemical treatments of the grains may likewise reduce mycotoxin contamination in flour.

Besides protein content and composition, the baking performance of organic wheat bread also depends on flour starch damage, amylase activity, ash content and particle size distribution (Fisher et al 2005). Two technologies for grain fractionation coexist for organic wheat with grains being processed either by stone milling or roller milling. The milling technique has a great influence on both baking performance and nutritional value (Chaurand et al 2005). Following recommendations of nutritionists, the future trend for the milling industry will be to produce flours richer in micronutrients and fibres. The stone milling system generally results in recovery of more or less integral flours richer in micronutrients and fibre, but the sensory quality of the end products (bread volume and colour) is less appealing for sceptical consumers.

Specific objectives

The overall objective of this project is to identify agronomical and food processing technologies that enhance the baking quality and the nutritional value of organic wheat and reduce mycotoxin contamination. Specific objectives are to:

- Evaluate the current practices for organic grain wheat production and flour-processing in Europe.
- Improve crop management strategies to enable bread-quality wheat to be produced on organic farms with and without livestock.
- Develop optimal post-harvest treatment to prevent mycotoxin contamination and enhance bread making quality and nutritional value.
- To generalise results from experiments in order to enhance farm management strategies in other climates and soil types.

The project is organized into five work packages:

WP1 deals with the project management and the communication with stakeholders.

WP2 will manage the field experiments involving soil and N management regimes including N fertilization, by either establishment of high-N-fixing legumes as green manures or by intercropping.

WP3 will manage the post-harvest experiments to (1) enhance baking quality and nutritive value through optimal extraction using either roller or stone milling and (2) limit contaminants by physicochemical treatments.

WP4 will evaluate technological properties of grain and nutritive value and baking quality of flour and determine mycotoxin contamination of grain and flour.

WP5 will use modelling approaches to describe the different cropping systems, using the experimental results from WP2 to generalise results on yield and quality indicators for other climates, soil types and management strategies. An additional economical analysis will determine the financial viability of the different technologies, as used under various economical conditions in Europe.

Project description

WP1. Project management and communication (ISARA)

This WP involves running lab and field experiments linked with measurements of quality parameters and use of modelling and scenario analyses. Coordination of project plans, reporting and cooperation between the different tasks in the project will be ensured. The WP will manage cooperation with farmers, millers and stakeholders through a database on organic wheat and flour production in Europe based on interviews joint with a literature review. The WP will ensure an effective communication through national and international journals, magazines, presentation at conferences and the maintenance of a website with general information on the project and its results.

WP 2. Field experiments

WP2.1. Soil tillage management (ISARA, ESA, FIBL). The effects of soil tillage and fertility managements will be assessed in three long-term field experiments. The trials represent various soil types and climatic conditions: Site 1 is located in SE France on a sandy loam soil; site 2 is in W France on a silty soil and site 3 is in NW Switzerland on a heavy loam soil. The experimental factors in France are (1) conventional tillage (mouldboard ploughing, 30 cm depth), (2) shallow ploughing (18 cm depth), (3) reduced tillage (15 cm depth without soil inversion) and (4) superficial tillage (5 cm depth without soil inversion). The fertilization management at both sites is similar in the four treatments. The experimental factors in Switzerland are (1) soil tillage management with conventional tillage (mouldboard plough followed by rotary harrow) versus reduced tillage system (chisel plough followed by rotary harrow), (2) fertilisation with slurry alone versus manure compost and slurry (both systems at a level of 1.4 Livestock Units ha^{-1}) and (3) biodynamic preparations versus no biodynamic compost and field preparations. A 5-year crop-rotation survey set up in 2004 on 12 farm fields in SE and W France compares conventional tillage with reduced tillage. In the present project, an average of 3 organic wheat fields will be followed each year.

WP2.2. N fertilization (BOKU, DIAS, FIBL, ART, ISARA). A European database on organic fertilizers and amendments will provide information on (1) N, P, K and C contents and (2) N mineralization kinetics of the most frequent organic fertilizers and amendments used in organic wheat production in Europe (selected from the survey in WP1). Farmyard manures (fresh and composted), mixed composts and organic commercial fertilizers will be analysed for carbon content, nutrient content and N mineralization kinetics. The results will be used for the soil-crop modelling (see WP5).

The effects of animal manures and organic fertilizers and N availability will be assessed in longterm

field experiments, such as the Organic Farming Crop Rotation in Denmark (since 1997; Olesen et al 2000). Grain of winter wheat will be collected at the three experimental sites in 2007-2009 from rotations with high/low proportion of N-fixing crops, and with/without supply of animal slurry (110 kg N ha^{-1}). In the DOK-Trial in Switzerland (since 1978; Mäder et al 2002), winter wheat is included in a 7-year crop rotation in biodynamic and organic systems with manure and slurry application at 0.7 and 1.4 livestock units ha^{-1} and in an unfertilized control. Data on wheat from 1978 to 2005 are available. Samples from 2006 and 2007 will be used for further quality analyses (see WP4). In a stockless organic farming system in Austria, grain of winter wheat fertilized with forage legume-derived compost, silage, or anaerobic digested residue will be sampled in 2008 and 2009.
*WP2.3. Green Manure (DIAS, BOKU).*The influence of a legume green manure in a crop rotation will be investigated in the Organic Farming Crop Rotation in Denmark (Olesen et al 2000). Two soil types (loamy and sandy) and climates will be represented. The influence of legume green manure will be compared by collecting winter wheat grain from two crop rotations with and without inclusion of green manure. Grain of winter wheat will be sampled in 2007-2009.
A study of the influence of the removal of green manure for fodder use and its replacement with farmyard manure, simulating a livestock system (0.5 livestock units ha^{-1}) in addition to stockless systems will be carried out in Austria in a long-term trial established in 2003 (Surböck et al 2006). Two 8-year rotations are running, one with green manure and straw being incorporated as in a stockless system, and one with removal of green manure and straw in turn to application of farmyard manure to winter wheat at 150 kg N ha^{-1}. Grain of winter wheat will be sampled in 2008 and 2009.
Interactions between type of green manure and time of incorporation will be investigated on a sandy loam at Askov in Denmark. In a field experiment initiated in 1981 (Thomsen and Christensen, 2004), three green manure treatments after spring barley were included in 2003: ryegrass, grass-clover and none. Half of each plot is ploughed in late autumn; the other half is ploughed in spring. In the growing season 2007/2008, winter wheat will be sown after the autumn ploughing and spring wheat after the spring ploughing. Grain of winter and spring wheat will be sampled in 2008.
WP2.4 Intercropping (ESA, ISARA, ART). Experiments on winter wheat-pea intercrops are carried out by ESA at two sites (2 years). Wheat-pea is grown in either a 50/50 ratio of a monoculture seed rate (W50-P50) or 70/30 ratio (W70-P30) with three N fertilization strategies: no application (N0), late N application (a month before flowering) (N1), application at the same time as for wheat monoculture but proportional to wheat density (N2). Mixtures are compared with monoculture wheat without N fertilization (W100-N0) or with optimum (date and amount) N management (W100-N) based on N status decision tools (David et al 2005c). Experiments on wheat-clover mixtures are carried out by ISARA (2 sites) and ART (3 sites). Winter wheat is sown directly in white clover at a density of 300, 450 and 600 grains/m². In the control treatment, the winter wheat is established with the same density on a bare soil. Grain of winter wheat will be sampled in 2007-2009. For ART, grain analyses will be performed on experiments already conducted.
General assessments in WP2: weed and disease pressure at flowering and at wheat maturity will be evaluated. Wheat grain yield, grain protein content and composition will be determined and provide the basis for decisions on grain delivery to WP3 and WP4. Soil fertility (Org C and N, microbial biomass, earthworm counting and activity) will be evaluated on WP21.

WP3. Post-harvest treatments (INRA, INRAN, Goëmar)
Grain samples from WP2 varying in DON and vitreousness degree will be selected. Milling tests will be carried out with either roller milling or stone milling using three extraction rates: 70, 80 and 90%. Flour will be analysed for its technological, nutritional and hygienic quality (see WP4) and the optimal extraction rate will be determined.
Pre-treatments (dehulling and ozonation) and post-physico-chemical treatments (heat treatments) suitable for organic processing will be tested by INRA in collaboration with Goëmar Industry. These complementary treatments will be studied on samples selected from WP2 that exhibit a high level of DON with different baking values, vitreous and floury kernel texture. Detailed attention will be paid to the characterization of the redox status of flour components in relation to dough rheological properties (proteins) and nutritional properties (antioxidant potential). Finally, a combination of different complementary treatments will be studied in order to define optimal conditions to improve flour characteristics.

WP4. Grain and flour quality (INRA, INRAN, DIAS)
Grains collected in the field experiments (WP2) and exposed for different pre and post-treatments and

milling techniques (WP3) will be provided. Analyses of hardness, ash, total protein, dietary fibre, bound hydrophilic antioxidants will be performed together with some specific physico-chemical parameters for proteins such as Zeleny sedimentation index and gluten index and flour rheological properties (farinograph, alveograph, gluten index, extensibility test, sedimentation test). Phytate content and protein composition (size of protein polymers, gliadin to glutenin ratio, HMWG to LMWG ratio) will be performed together with analyses of granulometry and damaged starch and DON contamination. INRA and INRAN will take care of the technological and nutritional evaluation, and DIAS will take care of the safety aspects by performing analyses of the DON.

WP5. Scenario analyses and synthesis (INRA Grignon, FIBL, ISARA, DIAS)
WP5.1 Soil-crop modelling and environmental assessment. A typical crop rotation and crop management for organic wheat growers will be constructed from the survey in WP1. Assessment of the changes in crop rotation and crop management practices will be performed using the FASSET (Olesen et al 2002) and Azodyn-Org (David et al 2004) soil-plant-climate models, which have been thoroughly tested for use in organic farming systems. These models effectively capture effects of various cropping systems and input level on crop production, grain protein (David et al 2005c) and soil organic matter (Berntsen et al 2006) and include competition between species and simulation of legume-cereal intercrops (Berntsen et al 2004). The models will be used to evaluate effects of modifications of crop rotation and crop management practices as suggested by WP2 on grain yield and protein, soil organic matter levels, N leaching and nitrous oxide emissions. This will be performed by setting up these models for several sites in Europe, corresponding to the experimental locations using the soil and climate characteristics. The models will be run for several years of climate data for each site to account for climatic variation, and the results will be compiled and compared across sites and management practices to get a total environmental evaluation of the crop management practices.
WP5.2 Economic assessment. An economic simulation model will be developed analysing the economic impacts of these innovations for typical quality-wheat producing farms in CH, IT, DK and FR. During the 3rd project meeting, the economic results explored in WP2 and WP3 will be evaluated for 10 typical farms producing quality wheat in the partner countries. The economic simulation model will simulate the financial effects for varying levels of yields, costs and prices and will provide information about the sensitivity and robustness of the results. Furthermore, the limitations and constrains for on-farm implementation will be identified.

Dissemination plan for scientific papers and popular science information
Strong focus will be on publishing the results in high quality international journals to ensure an optimal exploitation of the results by the scientific community. The research results on the effects of agronomical and technological methods on organic wheat quality, the ecological and economic assessment of these methods, and the development of decision-making tools will be published in relevant peer-reviewed scientific journals. Further dissemination will be achieved by attendance at national and international meetings, workshops and symposia such as those organised by ISOFAR, European Society for Agronomy and European Soil Science Society. A website will be set up to increase dissemination to representatives of national and international organisations of research or institutions and of farmers unions within organic farming. General presentation of the project, annual reports and publications will be presented on the website. The project will maintain a discussion with stakeholders (especially in WP1 and WP5) to ensure that the results of the project address the needs and are in line with the current development of the organic wheat-flour chains. This involvement will contribute significantly to the dissemination of the results to organic farmers, millers and advisers. The publication of the results in popular science journals, farmers' and millers' magazines and the organization of open field days yearly at the different experimental sites will also contribute to this objective. Several of the partners are also involved in teaching and will contribute to a growing interest in innovative agronomic and technological methods to promote a competitive organic agriculture in Europe. For each dissemination activity, a clear reference to CORE Organic will be made. All publications deriving from this project will be uploaded to the international open access archive for papers related to research in organic agriculture (Organic Eprints).

Added value of the collaboration between the partners
The consortium brings together partners within Europe, with complementary, internationally respected expertise. It will provide new knowledge on the wheat-flour chain through (1) the use of long-term

experiments on soil tillage and N management, (2) the assessment of innovative crop management and/or milling processes and (3) the combination of agronomical and technological methods. The use of the ongoing long-term experiments provides a considerable added value since long-term effects of management on soil fertility are essential for estimating effects on crop yield and quality of organically grown bread wheat. These long-term experiments are rare and very costly to run, and this transnational use of some of the most interesting long-term experiments in organic farming therefore provides a unique opportunity for clarifying some of the critical crop management effects on quality of bread wheat in organic farming. This multidisciplinary consortium will facilitate the dissemination of the findings and technical advances on both agronomical and technological methods to improve organic wheat and flour quality and safety across Europe. The research results will benefit the competitiveness of European organic agriculture and related food industries.

Milestones

No	WP	Date (yr/month)	Description
1	1	2007-09/09	Project meetings with preparation of annual and final reports.
2	1	2007/10	Project website implemented.
3	1	2007/11	Organic wheat survey (interviews and peer review) completed
4	2	2008/07	European database on organic fertilisers and amendments built.
5	2	2007-09/12	Field experiments completed and grain delivered to WP3 and WP4.
6	2	2008-09/12	Field data ready for supporting decision-making tools and models (WP5).
7	3	2010/4	Evaluation of extraction rates with stone and roller mills completed.
8	3	2010/4	Evaluation of quality of flours produced with varying pre and post-milling treatments completed.
9	4	2010/6	Analyses of the influence of growth conditions and pre and post-treatments on the technological, nutritional and safety characteristics of organic wheat for baking completed.
10	5	2010/10	Soil-crop modelling and environmental assessment completed.
11	5	2010/10	Economic assessment completed.

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Appendix B - Participating scientists

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13. Signature (the coordinator confirms that the given information is correct)**:**

Date Signature ______________________________