A10. Keywords

Max. 5 keywords to describe the project activity.

Wellfare, aminoacids, prebiotic, recycling lavae.

A11. Short project description/summary on objectives, activities, and expected results, both in Danish and English language (max 1500 characters, incl. spaces for both languages)

Formål

At udvikle og demonstrere et robust system til fremstilling at et nyt økologisk fodermiddel, baseret på patogenfri insektlarver med en ideel aminosyresammensætning, hvilket betyder at EU's krav om 100 % økologisk foder kan efterleves i fjerkræbesætninger og samtidig opnå en generel forbedring af velfærden i fjerkræ. At undersøge larvernes effekt på gødningens mikrobiologi herunder udvalgte patogener og zoonotiske bakterier og dermed den mikrobiologiske sikkerhed i systemet. At undersøge hvordan fodring med larver påvirker tarmsundhed og modstandskraft i fordøjelsessystemet. At demonstrere dette integrerede ON- farm system til biologisk behandling af husdyrgødning og recirkuling af N og P til foder og udnyttelse af kompost. Endelig undersøges effekten af fodringen på økologisk æg og kød produceret med den nye fodersammensætning gennem smagstest og laboratorieundersøgelser.

Objectives

To develop and demonstrate a robust system to produce a new organic feed supplement consisting of live insect larvae with an ideal amino acid composition. The project provides a sustainable way to meet the requirement from EU for organic farms (100% organic feed by 2012) and improved animal welfare in poultry flocks. To investigate the effect of larvae growth on the microbiology of the manure, including selected pathogens and human zoonotic bacteria to assess the microbiological safety of the system. To investigate a prebiotic effect in the digestive system of poultry. To demonstrate that the integrated ON-farm system is ideal for treating animal manure through composting with larvae and thereby recycle energy, N and P . To investigate the effect of feeding on organic meat and eggs produced with the new feed composition through taste tests and laboratory tests. To demonstrate the high value of larvae digested manure as greenhose and garden organic fertilizer product.

A12. Project description

(All parts of A12 must be filled out. Use "Garamond" as font, and font size 12, single spaced)

A12.1 The project objectives (2-3 lines). Research and development of 100 % organic feed in poultry diets with optimal aminoacid composition and high productivity. To verify the prebiotic effect of compounds in the insectlarvae and investigate effect on animal welfare. Demonstrate that combined manure composting and larvae production for feed is a robust system and a sustainable way to recycle nutrients in agriculture. To evaluate the entire chain including economy and end product taste and quality.

A12.2 The background and idea (hypotheses) incl. the national and international "state of art" and incl. references relevant for the section (max. ¾ page). A challenging aspect of organic egg and meat production is provision of a balanced nutrient supply. Essential amino acids, such as methionine and cystein, and the fatty acid linolene, have been difficult to provide in sufficient quantities in organic feed (Defra 2006). Insufficient feed results in suppressed production which again results in a lower production of eggs, slower growth and higher mortality due to behavioral problems like feather picking and cannibalism. Such problems are commonly registered in organic layer flocks. Insufficient quantities of the essential amino acids methionine and cystine feed in the organic layer flocks contribute significantly to this problem (Neal 1956, Hughes 1972). Cannibalism in layer flocks may be subdued by feeding fishmeal, a feed which is rich in amino acids. However, amino acids may also be supplied from living fly larvae and insects, since they have been shown to be especially rich in essential amino and fatty acids (Stanley –Samuelson 1988). In nature, insects and insect larvae are main feed sources for poultry, and it has been suggested that the larvae contain substances that may promote better defense against pathogens either by supporting the immune defense or as a prebiotic by stimulating the colonization resistance in the intestinal flora. The feed formula can be balanced in conventional poultry production by using synthetic amino acids, but this is not possible in organic production where all elements should be of organic origin. The possibilities for balancing the nutrient composition in organic feed are limited. So far this problem has been solved by supplementing with non-organic feed, but from 2012 organic feed need must have 100 % organic origin in order to comply with new EU legislation. This result may be organic feed with protein of lower biological value, which again may result in lower feed conversion rates, reduced productivity, a surplus of nitrogen excreted in the manure, and in relatively high ammonia and GHG emissions. Manure from poultry is rich in ammonia which makes it an unbalanced fertilizer. However when larvae are growing in the manure, 40% of the nitrogen content can be built into protein. The composted manure is therefore a better fertilizer. Therefore, the deployment of the larvae will have positive environmental effect since N and P recycled to feed, and loss of ammonia from manure in stables and field is reduced. Search for alternatives to expensive protein like fish meal have drawn attention towards the possibility of mass rearing insects using fresh manure and residues from fruit or plant production as a substrate. This alternative transform waste to value and use nutrients in an intelligent and organic way. The nutritive value of insects as feeds for fish, poultry and pigs has long been recognized, e.g. in China where studies have demonstrated that insect-based diets are cheaper alternatives to those based on fish meal. Throughout Asia primitive insect rearing for feed purpose in aquaculture and agriculture is well known and in some countries insect meal is now a component in pet food. Research in USA has concentrated on the Black soldier fly larvae (Hermetia) which is not a native fly in Northern Europe. However, early research in other fly species has shown that house fly larvae perform similarly to black soldier fly and can be farmed without the risk associated with introducing foreign species. A litterature review in UK concluded that house fly larvae is a good candidate for a new protein and fat source for poultry (Defra, 2006), but the concept also has great potential for aquaculture. Research carried out in USA and Germany indicate the larvae may be a valuable

supplement in fish feed when used as partial replacement for fish meal and fish oil, resulting in comparable or superior fish meat quality.

A12.3 The projects contribution to solving important challenges for the organic food, agriculture and aquaculture sectors and the general political goals regarding food, agribusiness and environment as expressed in the governments Green Growth programme. Including an explanation of the projects focus on respectively the entire product/value chain or selected parts here of (e.g. primary production, processing, trade and transport) – max. ½ page.

The BIOCONVAL project contribute to fulfilling the objectives in the Green Growth agreement and the project targets for more of the challenges that the organic sector faces right now.
The coherent research, development and demonstration effort targets the need for a future production of a 100% organic based poultry diet. The use of a novel protein source with more balanced aminoacid composition will be competitive to soya and fish meal.
The reseach focus on documentation of the biosecurety on the organic farm, food safety and eating quality of organic eggs.
The development of at composting system using common house fly larvae to convert manure to high value feed under Danish conditions will ensure that the practical barriers for establishing a production on farms can be evaluated and solved through the project.
The development of the system will result in a positive impact on environment since N and P are recycled on the organic farm and the manure handling will change into a system where manure is removed on a daily basis. This will result in a low emission from house and from landapplication of the larvea-composted manure. In addition the internal and external transport of feed and manure will be reduced resulting in a lower carbon footprint and costs.
The production of a high value protein and high value compost based on convertion of residues is a strong alternative to other manure treatment systems especially the burning of poultrymanure.

A12.4 The projects innovative value, relevance and effect including the specific barriers and development potential for the organic sector the project will solve and/or support (max. ½ page).

It is so obvious to feed poultry with live insect larvae since it is their most important natural source of proteins and lipids. Yet it is not used in (organic) farming due to a lack of conscience about the potential and due to a need for a series of highly value adding innovative steps to realize the ideas. Taking a seemingly simple concept and exactly through "innovation for simplicity" transform it into a robust farm level concept is one of the core values of this project. The relevance is extremely high since the concept is applicable for large range of domesticated animals which in their natural habitat feed on live insects, i.e fish, chicken, fur animals and pigs. The relevance for the organic egg producers is particular since they strive to feed their livestock a proper amino acid balance for the benefit of animal nutrition and welfare, but without losing excessive amounts of nitrogen at a farm level due to a poor amino acid balance in plant derived proteins. For the organic agricultural system as a whole there is a need for reducing the dependence of imported protein feeds, and rather focus on clever recycling of energy and nutrients. From 2012 European organic farmers can no longer add any non organic protein sources to their feed, and there is therefore an urgent need for developing alternative high protein organic feed sources, without excessively increasing the demand for land use and more fertilizers. Waste from organic farming and food production, including food waste from institutions with dedicated organic food policy, is often lost through destruction and incineration or used for composting or biogasification. By taking all these available sources and use them as larvae feed substrate, the high quality feed input, as well as N-input, to the organic farms can be increased without extra land use and without import of feed ingredients. The main barriers identified so far is the need for investment in concept development and demonstration as well as the barriers towards introducing completely new ideas and concepts in the agricultural production system, however obvious they may seem.

A12.5 Description of activities, methods and expected results divided into work packages with clear denotion of which activity the applicant consider to be either Research, Development or Demonstration. The coherence between work packages must be clearly described and the relation between activities and the tables with milestones and deliverables must be logical and consistent. Moreover, the primary target groups should be clearly identified with a description of how these will be met by the project (max. 1 page per WP and max. 3 pages in total).

WP1. Development of larvea rearing technology and demonstration on farm scale
(DTI (lead), KCA, Egg producer, US/Slovak experts)

Demonstration of the concept on farm scale implies:
- Construction of a basic larvae rearing system, based on consultancy services from highly experienced external sub suppliers in USA and Slovakia.
- Adaptation and development of the system to fit typical Danish farm infrastructure
- Development of manure feeding system
- Adaptation of farm management.

The main task of WP 1 is to set up a prototype larvae rearing system, which can be further developed for commercial application in Danish organic agriculture. The technology will be developed with assistance of US and Slovak consultancy, which provide services based on 20-30 years experience.The Slovak partner can deliver fly eggs during the first halfof the project, whereafter it is expected that a danish company will take over this business venture. In addition to the technical installation the concept will be subject to a thorough environmental impact analysis including assessment of nutrient house-keeping on a the farm level and within the agricultural system, management of feed protein within organic farming and effect on green house gas and ammonia emission which is most likely to be affected by the changed manure management practices which is a consequence of the concept. Finally the expected overall economy will be assessed based on information about expected net investments and gained benefits

WP2
Documentation and demonstration of fertilizer product
(DTI, KCA + Farmer Gødning, subcontractors (Nursery, laboratories)

It has previously been demonstrated in a labscale project (EU-Life project: www.ecodiptera.info) that the remaining manure product following larvae digestion is an excellent high value fertilizer product, especially suitable for gardening and greenhouses. Testing and documentation is necessary in order to make the fertilizer product a commercial valuable byproduct of the concept, which may contribute significantly to the farm level concept economy. WP 2 will provide :
- A hygienic analysis of the fertilizer product,
- Test the nutrient content (N, P, K)
- Test the nature of the organic content and evaluate soil enhancing effect.
- Tests and documentation from field trials with the fertilizer product

WP3
Microbiological risk assessment of using non-heattreated insect larvae as a feeding additive in the organic production of poultry.
Veterinary Institute (lead), DTI, Food institute

In this work package we will evaluate risk factors for using fresh House fly larvae (Musca domestica) for feed supplement in the organic poultry production. In this production most waste are recycled, in order to maintain nitrous, phosphorus and carbon sources in system, however there is a potential risk also for accumulating bacterial, viral and parasitic pathogens as well as environmental chemical contaminants e.g. dioxins. To evaluate the potential risk of these problems, we will establish an experimental infection model to study the capacity of these larvae to eliminate pathogens in the manure and their capacity for self-cleaning. In the model, manure will be contaminated with relevant representatives of pathogens: bacteria, coccidia, parasites and virus, and their elimination both in the manure and inside the larvae will be followed during the conversion of the manure. The level of dioxins in larvae and manure will also be measured to evaluate whether larvae may accumulate this due to their high lipid content. If necessary, strategies to disinfect larvae will also be evaluated. All data will be compiled into a risk assessment analysis of using non heat treated larvae as feed for poultry.

Tasks:

- Development of a model system to test the ability of larvae to inactivate pathogens in the manure
- To test whether larvae may be able to transmit pathogens or environmental chemical contaminants from the manure
- Evaluate ways to decontaminate larvae
- Qualitative risk assessment of feeding with living larvae

WP 4
Investigations in the prebiotic effect of fresh insect larvae for animal health for the production of organic poultry
Veterinary Institute
In this work package we will conduct feeding and infection experiments in our isolator facility with ecological layer chicks. In nature larva and insects are important feed sources for poultry, and fly larvae have shown to be especially rich in essential amino and fatty acids (Stanley-Samuelson 1988). But it may also contain other unknown substances with positive biological value for improving the immune system or by acting as a prebiotic substance that favors an intestinal flora with a higher colonization resistance against pathogens as E.coli or by the zoonotic Campylobacter. By feeding with standard ecological feed or supplemented by either fresh larvae or meal, we will monitor growth performance, behaviors (feather picking), and collect intestinal samples to investigate the influence of the different ratios on the intestinal flora. Chicks will be challenged with Campylobacter either by oral inoculation or by feeding infected larvae late in the experiment and the impact on the flora investigated.

Tasks:

- Conduct a infection studies where we will compare the performance of layer chicks fed either fresh or larvae meal, and describing the intestinal flora
- Study the colonization resistance of these by challenging these with Campylobacter.
- Describe the dynamics in the intestinal flora of these birds using molecular methods as 454 pyrosequincing technology

WP 5 Wellfare, productivity and food quality
(KCA, DTI Organic farm, food quality laboratory)

The objective is to demonstrate the effect of feeding larvae to layers, on nutritional value of the feed, productivity of the hens, animal welfare and egg quality.

The work package will be devided into the following tasks and subtasks:

Development of a feeding method and a nutritionally well balanced diet including larvae
The idea is to feed the whole untreated larvae to the hens every day. The microbial analyses in WP 3 will show if this idea is sustainable. Alternatively, the larvae will have to be heat treated before feeding them to the hens. A suitabale feeding method will be developed. One possibility is to use an automatic distribution system by means of an automatic feeding robot (rail based system) that distribute the larvae evenly over the litter area. This will activate the hens and stimulate their fourageing behavior and keep the hens busy, thus minimizing behavioral bad habits

Feeding trail design and feed formulation
The idea is to arrange trial facilities including automatic feeding system for larvae on a commercial organic layer farm. The production unit will be devided into two identical stables in order to be able to registrer productivity (feed consumption, egg yield etc.), wellfare (feather picking, mortality, behavior) and to be able to collect samples of feed, eggs and faeces from hens fed diets with or without larvae. Faeces samples will be investgated and analyzed as decribed in WP 3.
The aim is to use a standard feed formulation in the control group and to develop an isoproteinic experimental diet including larvae. The nutritional value of feed with and without larvae will be determined based on chemical analyses and based on the registered effects on the birds, including productivity, welfare and quality of eggs.

The effect of larvae feeding is tested on layer performance, welfare and product quality. The trial will be carried out during at least one - or preferably two full production periods corresponding to 2 x 13 months. When half of the trial period is gone, the trialfeeding will be changed from one unit to the other, in order to eliminate any possible environmental effect on the parameters registered. During the whole trialperiod no of eggs, eggweight, feed consumption, water consumption and mortality will be registered every week in the trialflock as well as in the control flock. Every third month samples of feed, droppings and eggs are collected for laboratory analysis, including chemical analysis of nutrients, microbiological tests . Every third month an evaluation of animal welfare is caried out, including feather score (Tauson), cannibalism, mortality and behavior (confidence, shyness, calmness, fear)

Analysis and describtion of experimental data in a repport
Decribtion of trial design including feed formulation will be reported, as soon as technical changes in the trial unit has been implemented. Parameters registered on a weekly basis will be reported once a month. This monthly report will include a dynamic indication of the economic impact of larvae feeding (wins - costs).

Laboratory sensory research on eggs (sampled in 4.3)
The objective of this task is to evaluate market potential for organic eggs from layers fed whith larvae supplement before any company spends valuable resources on its marketing and distribution.
Sensory research studies is performed to discover if consumers have taste preferences or preferences based on knowledge about the production and feeding of animals.
Content:
- Consumer Acceptance & Preference Testing
- Triangle (Discrimination) Testing
- Descriptive Testing

(Laboratories/test panels attends on consultancy basis)

A12.6 Description of how it will be ensured that the project results can be implemented in practice and perhaps commercialized (max. ½ page).

The full scale On farm system for composting of manure and other organic residues and a production of live larvea for feeding to avian hen will be demonstrated in practice on a comercial farm. This will involve open house visits by organic and conventional farmers and relevant industry partners who is expected to be interested in a license for the american system on the european marked. Results will be described in relevant agricultural magazines and on websites like "landbrugsinfo.dk"

Results will be presented on seminars and technology fairs and direct contact with feed companies who has already shown interest in insect meal production for use in poultry and fish feedformulation as an alternative to fish meal.

The company "Farmer Gødning" is ready to scale up production of a organic product for nurseries. The perspectives for implementation of the system on biogas plants as a pretreatment where valuable nutrients are removed before entering the reactor will be evaluated and if possible followed up by experiment on biogas potential.

A12.7 Description of possibilities for a general utilisation of the results (max. ½ page).

The need for a balanced organic feed whitout use of synthetic aminoacids is a challange for all monogastric farmed species (pig, fish, duck,turkey).
All results from the research including analysis of the feed composition etc. will be available for feedstuff companies who has already shown interest in testing of a processed larvea product (larveameal) in conventional and organic feeds. This has great perspectives not only for poultry feed but for other farmed species including aquaculture. The perspectives in fish feed are very important since the production of farmed salmon today requires 1.5kg wild fish for each kg of farmed fish. In a world wih depleted fish reserves this is not a sustainable development and the alternative is straightforward to use larvea meal in the future instead of fishmeal.

In US there isthe system is used already for production of pet food and this could be a possible next step for commercialisation in Europe too.
Larvae or processed larvea or pupae could be used occationally as "trouble shooting" for hen flocs where canibalism and fether picking is seen. This can be seen as an alternative to every day use and on farm production of supplements.

The developed technology could be used directly on conventional poultry farms where it will be easy to implement since frequent of manure using belts under slats in layer houses is a more widespread technique. Previous studies on larvea conversion of pig manure fibers has shown that this is posible too. However this will require a new manure management on pig farms to ensure fresh manure as feed for larvaes.

Insect production for farms is used today for control of houseflies on pigfarms. Distribution of live larvea for manure composting and feed production could be a future marked for these companies as an alternative to on-farm production.

A12.8 Description of the coherence between the research, development and demonstration activities in the project, including involvement of relevant users of the results (max. ½ page).

Research activities are mainly focuses on applied research in productivity, animal welfare and risk assesment . It is carried out by monitoring the production on a commercial organic farm throughout the project and sampling of products (hen, egg, bacterias, manure) directly from the farm. The expected result includes higher productivity and improvement of welfare which are parameters of great economic influence and therefore of high interest for the farmer.
The farmer will get introduction to the system including a course in running the flyegg hatchery and needs for optimal climate controll etc. This education will be arranged by the American company that holds the patent for the system.
Users of the end product - organic eggs and meat will be involved in a panels for test of the impact on eating quality.
The food security is essential not only for the human health but for the consumer view. However the consumer view will be affected by the fact that not all consumers has the initial understanding that it is natural for the hen to eat insect, larvea and pupaes and that this behavior is important for the digestion. Therefore the resuls will be presented in consumer magazines (coop) and a survea on the general opinion of the system will be conducted.

A12.9 Project organisation, management and administration (max. ½ page).
The overall management and coordination between activities in the different work packages is conducted by a steering committee which will meet at least every six months or upon request from one of the partners. Each partner has a member in the steering committee, which select a chairman. DTI will discharge administrative functions of the project and appoint a secretary of the steering committee. Professional management is conducted in each work package by the work package leader.

In addition to the professional management, a coordination committee with responsibility for knowledge dissemination will be appointed by the steering committee. The role of this committee is to establish a homepage for the project as well as distribution of newsletters, planning and managing meetings and thematic days. Project meetings will be held every six months (upon initiative from the chairman of the steering committee or upon extraordinary request from at least one partner) where all participants including students as well as technicians are invited to discuss project progress, share results and plan experimental work. The steering committee will gather at this occasion as well

A12.10. The technical competences of the partners and their contribution to the project including how they complement each other (max. 5 lines per partner).
Danish Technological Institute (DTI)
The Danish Technological Institute is a self-owned and non-profit institution.
We develop, apply and disseminate research- and technologically-based knowledge for the Danish and International business sectors. As such we participate in development projects which are of use to society in close collaboration with leading research and educational institutions both in Denmark and abroad.
The institute initiates has great experience on verification of technology and consultancy in all industries including environment techonolgy, fisheries and agriculture.
The DTI LIFE science Division includes experts on food technology, chemistry and microbiology who have experience in trouble shooting from several developing projects including projects in microbiology on poultry farms and hygene improvement.

DTU-VET is the national Technical University in Aarhus.
Research profile and strategy
The duties of the National Veterinary Institute include research, diagnostics, education, surveillance and consultancy in the area of infectious diseases of production animals including fish and the wild animal population. DTU VET is responsible for the laboratory part of the Danish veterinary contingency plan, and is appointed the official National Reference Laboratory for animal infectious diseases. DTU VET covers the

disciplines related to animal infectious diseases: pathology, bacteriology, virology, parasitology, immunology, serology, epidemiology and risk assessment.
For BioConval in particular, DTU has excellent facilities for working with manure under microbiological and environmental safe conditions, for working with microbiology (both calss 2 and 3 microorganisms), for larval culture and for advanced laboratory investigations of the samples

.

Knowledge Centre for Agriculture, the Danish Agricultural Advisory Service (DAAS) is a partnership made up of 31 local advisory centres and a knowledge centre. This unique two-level advisory system is both owned and used by Danish farmers. The Poultry department offers advisory service for organic and conventional farmes all over the country. The service covers all aspects of poultry production including veterinary service from own clinque. In this project the center will contribute in wp 1 with knowledge and experience concerning farm layout, logistics and technical requirements for manurehandling and feeding on farms, feed optimization. In wp4 the center will perform research in hen productivity, behavior and wellfare.

Farmergødning

Organic farmer

A12.11. Expected collaboration with other research institutions/companies nationally and internationally (max. ½ page).

Close collaboration with a range of industries within the business of farm level manure handling and feeding systems is expected, nationally as well as internationally. The concept will be demonstrated and advertized in relevant forums and is expected to attract new collaborators and generate business ventures within the organic farming community. The concept of insect husbandry is by no means limited to live feeding at the organic farm level. There is a huge potential to industrialize larvae production based on substrates from conventional farming and turning them into a standardized feed ingredient applicable for a range of domestic animal feeds. DTI has in collaboration with an international consortium submitted an application to the Danish research council for strategic research on the development of an industrialized system for production of insect based feed ingredients. Close collaboration with this consortium, which has international partners from USA and Slovakia, is expected. Although these projects have little practical overlap, a significant exchange of scientific knowledge about fly larvae biology and microbiology is expected. The research council project has a strong focus on the mechanisms behind the efficient bioconversion of the substrate, which is not the case for this project since it is designed towards demonstration, development and documentation.
In case both projects are realized they will both be a very valuable source of mutual inspiration for rapid progress of the development of the two different concepts. Finally, the project addresses a problem which is globally highly relevant, and therefore also attracts interest all over the world. The first results from this projects is therefore guaranteed to attract world-wide interest and fuel international collaborations

A12.12. The relation to previous projects within the projects focus areas (if any) including references to these (max. ½ page). Results generated at a running FERV Innovationslovsproject 'Fjerkræ _Insekters betydning for dyrevelfærd og sundhed' at DTU have reveiled results (unpublished) pointing at the benefit for egglayers of having access to eat live larvae, as this may reduce their tendency to feather pecking. This project also will provide basic knowledge for the effect on the intestinal health. However results are not ready yet, but when available, will provide the platform for the further studies of intestinal health at BIOCONVAL

A13. Tables with milestones and deliverables with information as requested in the table in A16.

WP1
Milestone 1 is reached when the expected optimal design of the larvae rearing system is identified and described such that the construction work can begin. The design is based upon thorough analysis of the facility requirements and the farm management including manure handling technologies.
Milestone 2 is the constructed physical larvae rearing system including manure feeding systems and technology for feeding the larvae to the hens and chickens.
Milestone 3 is a continuous larvae production corresponding to at least 200 kg pr m2 of rearing basin pr year. This is a conservative estimate which may well be exceeded in a well managed system.

WP2
Milestone 4 is reached when the first digested manure is thoroughly described an analyzed with respect to potential fertilizer value.
Milestone 5 is reached when all necessary treatment of raw larvae digested manure in order to process it into a commercial fertilizer product is identified. This may include drying and heat treatment in order to reach a satisfactory hygienic level of the product.
Milestone 6 is a completed field test of the fertilizer product which document the fertilizer value a soil enhancing properties as well as the commercial potential as high value product for gardening and greenhouse purposes.

A14. List of deliverables from the project (also fill out the table in A17)
A14 list of deliverables:
WP1
 # Results on digested manure which will deliver a complete description of the organic content, inorganic content and hygienic status of the larvae digested manure. The report will provide recommendations for further necessary treatment in order to transform the material into a commercial product, which may include drying and heat treatment to inactivate microbiology, remaining fly eggs and weeds. Delivery type will be: S3, S4, P1, P2
 # Results on digested manure treatment will deliver a complete description and procedure for producing a safe commercial fertilizer product from the raw larvae digested manure, including documentation of the product regarding fertilizer value and safety. Delivery type will be: S3, S4, P1, P2
 # Results from the quality test of the processed digested manure as a fertilizer will be delivered in the form of S4, S5, C4, P1, P2. The reports will describe the field test results and provide recommendation for use and commercial potentials.
WP2
 # Report with design plan for rearing system. Based on an analysis of the farm infrastructure and larvae rearing requirements, a complete description of the expected most efficient rearing system will be provided. These results will be delivered in the form of P1, P2, and serve as basis for constructing the prototype rearing system.
 # Report on completed rearing system. The deliverable will include a detailed description of the constructed prototype, and design solutions implemented to integrate the rearing systems into the farm infrastructure. Results will be provided such that the technology can be implemented on other farms. Experience and results from the rearing system prototype construction will be reported in the form of S3, P1, P2, C4.

Report on rearing management. This deliverable will include a detailed description of the management strategy for larvae husbandry with the aim of maximizing biomass output with respect to: Area of rearing facility, energy input, labor input and consumables. Results will be reported in the form of S3, P1, P2.

A15. List of appendices

1. CV for key persons
Arne Grønkjær Hansen (project leader), Birthe Hald, Steen Nordentoft, Lars D.M. Ottosen, Niels Finn Johansen

2. Literature list.

A16. Milestones and time schedule for the entire project

wp no.	Milestone no.	Title/activity	Responsible project participant	Date/year	Other participants
1	1	Larvae rearing system designed	DTI	10- 2011	KCA (US consultancy)
1	2	Larvae rearing system established	DTI	04- 2012	KCA (US consultancy)
1	3	Larvae production > 200 kg/m2/år	DTI	04- 2013	
2	1	Digested manure analysed	DTI	09- 2012	ext. lab
2	2	Necessary fertilizer treatment indentified	DTI	03-2013	
2	3	Fertilizer product field tested	DTI	09- 2013	
3	1	Laboratory facilites for larvae studies are ready	Veterinary Institute (DTU-VET)	07- 2011	
3	2	Facilites for hatching of larvae are ready and running	Veterinary Institute (DTU-VET)	10- 2011	
3	3	A testing model for lavae studies are generated and pilot studies are preformed	Veterinary Institute (DTU-VET)	03- 2012	
3	4	Possible ways to decontaminate larvae are described and tested	Veterinary Institute (DTU-VET)	12-2012	DTI
3	5	Inactivation studies with larvae model have been preformed and data have been analysed	Veterinary Institute (DTU-VET)	04- 2013	
4	1	Collection of samples from infections studies in isolater facilites have been terminated and all samples has been analysed	Veterinary Institute (DTU-VET)	04- 2013	
4	2	Dataanalysis are done	Veterinary Institute	08- 2013	
5	1	Detailed planning of technical changes described and agreed	Knowledge Centre Agriculture (KCA)	30-05-2011	DTU- VET
5	2	Technical Changes in production unit completed and trial period start	Knowledge Centre Agriculture (KCA)	01-02-2012	Organic Farmer (H. Vestergaard and subcontractors
5	3	Article published in Agr. Magazine and homepage developed (update every month)	Knowledge Centre Agriculture (KCA)		DTI
5	4	Final Report conc. trial 1 and 2 elaborated and published.	Knowledge Centre Agriculture (KCA)		DTI DTU-VET

A17. List over deliverables (D=deliverables) for the entire project, stating whether the deliverable belongs to the research part of the project (R); the development part (D); and/or demonstration (Dm).

D. no.	Deliverable	Responsible project participant	Date/year	R, D, or Dm Effective working time, months [1]	Type of deliverable*
1.1	Contract with farmer and ext. consultants	KCA/DTI	30-04-2012	D 0,3	
1.2	Report on design plan for rearing system	DTI	11-2011	D 4,0	P1, P2
1.3	Report on completed/demonstrated rearing system	DTI	05-2012	D, Dm,	S3, P1, P2, C4
1.4	Report on digested manure	DTI	10-2012	D	S3, S4 P1, P2
1.5	Report on digested manure treatment	DTI	04-2013	D 2,0	S3, S4 P1, P2
1.6	Report on rearing management (for target production of larvea)	DTI	05-2013	D	S3, P1, P2
2.1	Report on fertilizer product performance and analysis	DTI	09-2013	D1 Dm 3,0	S4, S5,C4, P1, P2
3.1	Describtion of the larvae model	DTU-VET	04-2012	R 9,0	P1
3.2	Report on the efficiency of larvae to decontaminate pathogens in poultry manure	DTU-VET	05-2013	R 8,0	P1
3.3	Report on the possibilites to decontaminate living larvae	DTU-VET	01-2013	R 3,0	P1
3.4	Qualitative risk assesment of using living larvae as feed for ecological egg layers.	DTU-VET	05-2013	R 3,0	P1
3.5	Manuscribt on the larvae decontamination studies submitted	DTU-VET	01-2014	R 2,0	S1, P2
4.1	Report on the feeding and infection studies preformed in the isolaters	DTU-VET	09-2013	R 4,0	P1
4.2	Manuscribt on the influence of feeding larvae on the intestinal flora submitted	DTU-VET	12- 2013	R 2,0	S1, P2
5.1	Trial plan 1. and plan for techn. changes	Niels Finn Johansen	09-2011	D 3,0	C4
5.2	Article 1.	Niels Finn Johansen	09-2012		P1
5.3	Reviced trialplan elaborated	Niels Finn Johansen	11-2012	D 1,0	C4
5.6	Interim report conc. 1 trialperiod	Niels Finn Johansen	01-2013	D 0,8	S3
5.7	Article 2.(semi scientific paper) conc. first trial period	Niels Finn Johansen	03-2013	Dm 0,5	S3
5.8	Open house arrangement	Niels Finn Johansen	05-2013	Dm 0,5	P2
5.9	Article 3. agr. magazine	Niels Finn Johansen	08-2013	Dm 0,3	P1
5.10	Final report on trial 1 and 2	Niels Finn Johansen	12-2013	Dm 1,0	S3

* Fill in the type of deliverable. Use the List of type of deliverables on the last page in Annex 3 "Instructions for filling in the application form".

[1] The total amount of months must be consistent with the total number of months in the budgets, and will therefore show the relative working effort per work package.