



General information	
PPP-number	AF14322
Title	Algae Linkages
Theme	TKI Agri & Food CIRCULAIR
Implementing institute	United farms,
Project leader research (name + e-mail address)	Lolke Sijtsma; e-mail: lolke.sijtsma@wur.nl
Coordinator (on behalf of private partners)	Lolke Sijtsma
Project-website address	https://topsectoragrifood.nl/project/algaelinkages/; https://www.wur.nl/nl/project/Algaelinkages-1.htm
Start date	01.03.2016
Final date	30.09.2020

Approval by the coordinator of the consortium	
The annual report must be discussed with the coordinator of the consortium. The "TKI's" appreciate additional comments concerning the annual report.	
Assessment of the report by the coordinator on behalf of the consortium:	<input checked="" type="checkbox"/> Approved <input type="checkbox"/> Not approved
Additional comments concerning the annual report:	

Summary of the project	
Problem definition	In Mexico, greenhouses and other primary production and processing activities need to cope with increasing demands regarding sustainability of their processes and especially water management. In current greenhouse production practices much of the water used is being drained without treatment, contributing to the overall water scarcity. Moreover, the residues of the fertilizers in the water give rise to large problems with regard to the groundwater quality. Straightforward re-use of the drain water in the greenhouses is impossible without further treatment, given that re-use will increase the salt content already present in the water. Microalgae are a solution to cope with this problem; they can grow on this drain water and make use of the remaining nutrients, cleaning the water and producing a valuable product for e.g. animal feed in the meantime
Project goals	In AlgaeLinkags a new, integrated and sustainable agrifood chain will be developed, using drain water from the Mexican greenhouse horticulture as a nutrient source for microalgae production. Next, this algal biomass will be studied as a healthy chicken feed to produce omega-3 enriched eggs. Future implementation of this agrifood chain will reduce the problems related to water quality in Mexico, and at the same time create a healthy and sustainable feed (ingredient) for enriched, healthy eggs. Once proven successful and economically

feasible the sustainable approach used in this project can be replicated in Mexico, the Netherlands and the rest of the world.

Results

Planned results 2019	<ul style="list-style-type: none"> - Production, processing and storage of over 20 kg algal dried biomass (<i>N. limnetica</i>) of good quality in Mexico and transport to NL for inclusion in chicken feed. After processing and transport the biomass should still contain relevant amounts of omega-3 fatty acids. - Perform feeding experiments of laying hens with algae enriched feeds in NL - Analyse effect of algae enriched feed on egg production and enhancement of n-3 fatty acids in eggs. - Start with possible positive effects of feeds enriched with algal biomass on health effects of laying hens.
Achieved results 2019	<ul style="list-style-type: none"> - A DNA analysis process was implemented in order to control the purity of the algae grown in photobioreactors. - A drying, mild milling and packaging process was developed. - After having optimized the production and quality control process, in 2019 over 60 kg algal biomass paste of sufficient quality and with sufficient amounts of n-3 fatty acids was produced in outdoor bioreactors, dried, vacuum packed in Mexico and shipped to NL (25 kg) for use in feeding experiments. - A feeding trial protocol was designed in which the laying hens were fed a diet containing different doses of the micro algae <i>N. limnetica</i> - The required permits for the feeding experiments were obtained. - In total, 240, 25-wk-old laying hens were randomly allotted to 30 experimental floor pens (8 hens/pen). The experimental diets were fed ad libitum for 28 days. Body weight was determined upon the beginning and end of the experiment. Feed intake, feed conversion ratio, egg production and egg weight were determined on a weekly basis. Eggs were collected from individual pens during the last 5 days of the experimental period to determine the fatty acid composition in the eggs. Faeces were collected during the last 3 days of the experiment to determine the digestibility of the diets - In conclusion, the inclusion of <i>N. limnetica</i> did not affect digestibility of the diets, which indicates that these microalgae can be used in laying hen diets without affecting overall nutrient intake. - Furthermore, microalgae inclusion resulted in a higher feed intake and affected the rate of lay and the egg weight. - This research showed that <i>N. limnetica</i> remarkably increases the omega-3 fatty acid (EPA/DHA) content, in particular DHA and slightly decreases the omega-6 content in eggs. - The yolk of the eggs turned "greenish" upon inclusion of algae in the feed. This needs attention with respect to potential application and marketing of the eggs enriched in n-3 fatty acids. - The feed trial also included one dietary treatment in which the main protein source was rapeseed meal instead of soybean meal. The rapeseed meal functions as a mild nutritional challenge to mimic the (gut) health challenges the birds usually encounter in practice. This diet also contained <i>N. limnetica</i> to counteract the effects of the challenge. At the end of the experiment several tissues were collected to measure health responses. Some of the analysis will only be done when initial results are promising

Planned results 2020	<ul style="list-style-type: none"> - In 2020 Process integration and economic sustainability will be estimated on basis of models (at 1-3 ha scale) - Information obtained in 2019 regarding feeding experiments and health aspects will be processed in more detail - Most likely, results of the feed trial will be presented at an international conference. - A publication on algae production and feeding experiments is foreseen - Results so far will be discussed and presented in Queretaro, Mexico, end April 2020 - A final meeting will be organised in NL (September 2020)

<p>Deliverables/products in 2019 (provide the titles and /or a brief description of the products/deliverables or a link to a website.</p>
<p><u>Scientific articles:</u></p>
<p><u>External reports:</u></p>
<p>Articles in professional journals/magazines: Plaisier, E. Posted: 15 January, 2020 Knowledge is transforming Mexican horticulture https://www.greentech.nl/news/knowledge-is-transforming-mexican-horticulture/. https://www.agroberichtenbuitenland.nl/landeninformatie/mexico/achtergrond/kennis_sp</p> <p><u>Interview by Sanne Dodde: Welk voedsel ligt er in de supermarkt van de toekomst (section, algen</u> https://www.duurzaambedrijfsleven.nl/futurefood/32823/voedsel-van-morgen?q=%2Ffuturefood%2F32823%2Fvoedsel-van-morgen&utm_source=nieuwsbrief&utm_medium=e-mail&utm_campaign=Daily+Focus+26+November Duurzaam Bedrijfsleven #21 / Winter2020, page 42-43</p>
<p><u>(Poster) presentations at workshops, seminars, or symposia.</u></p>
<p><u>TV/ radio / social media / newspaper:</u></p>
<p><u>Remaining deliverables (techniques, devices, methods, etc.):</u></p>

[https://topsectoragrifood.nl/project/algaelinkages/;](https://topsectoragrifood.nl/project/algaelinkages/)

<https://www.wur.nl/nl/project/Algaelinkages-1.htm>

<https://www.wur.nl/nl/Onderzoek-Resultaten/Topsectoren/show/Algaelinkages-1.htm>