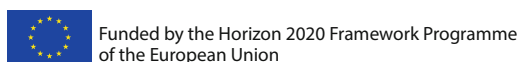


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Editors

# Aquaponics Food Production Systems

Combined Aquaculture and Hydroponic  
Production Technologies for the Future



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# Preface

It has been more than 45 years since the science fiction film *Soylent Green* (1973) first appeared in cinemas. The movie was prescient for its time and predicted many of our current environmental problems, including dying oceans, the greenhouse effect, overpopulation, and loss of biodiversity. Even though we hope that humans will not serve as a future nutrient source, the scenarios laid out in the movie are not that far from being realised. As researchers and citizens, we realise our duty of care to the environment and the rest of our world's ever-growing population. We are concerned that if we stand back and ignore the current trends in exploitation of resources and methods of production that our paradise of a planet will be doomed or at least far diminished, such that living on the sterile surfaces of the Moon or Mars will seem like a pleasant alternative. Generations to come will and should hold us individually and collectively responsible for the mess that we leave. The numerous authors of this book are in a lucky as well as in an unfortunate position, in that we can either help to solve problems or be held responsible by future generations for being part of the problem. When we started the COST Action FA1305 'The EU Aquaponics Hub – Realising Sustainable Integrated Fish and Vegetable Production for the EU', aquaponics was a niche technology that, at an industrial scale, could not compete with stand-alone hydroponics and aquaculture technologies. However, aquaponics technology in the past decade has taken great leaps forward in efficiency and hence economic viability through a wide range of technological advances. As our ability to understand the environmental costs of industrial farming increases, we are more capable of developing technologies to ensure that farming is more productive and less damaging to the environment. This positive outcome should be bolstered by the very encouraging signs that although young people are statistically not interested in being the farmers of the future, they do want to be future farmers if technology is involved and they can adapt these technologies to live closer to urban environments and have a better quality of life than in the rural past. Kids of all ages are fascinated by technology, and it is no wonder as technology solves many problems. At the same time though, kids (perhaps less so with teenagers) are also environmentally conscious and understand that the future of our planet lies in the

melding of nature and technology. Technology allows us to be more productive, and although we have no certainty that we can and will effectively solve climate change, we still have hope that there will be a future where people will be healthy and fed with nutritious food. We, the authors of this book, realise that we are but small fry in a world of much bigger fish (sometimes sharks), but we are more than hopeful, indeed confident, that aquaponics has a role to play in the world's future food production.

Within the timeline of COST Action FA1305, our objective was to bring aquaponics closer to the public and to raise awareness of alternative growing methods. The Action's Management Committee had 90 experts from 28 EU countries, 2 near neighbour countries, and 2 international partner countries. We organised 7 training schools in different parts of Europe, involving 92 trainees from 21 countries, and 20 STSMs were awarded to 18 early career researchers from 12 countries. Most importantly, we published 59 videos based on the training schools, all of which are freely available on YouTube (<https://www.youtube.com/EUAquaponicsHub>). Action members collaborated in writing 24 papers (19 of which are open access), book chapters, monographs, and a white paper. The white paper identifies eight key recommendations based on the experience of the working group members, trends within current research and entrepreneurship, and the directions being investigated by ECIs. The recommendations are:

1. The promotion of continued research in aquaponics.
2. The development of financial incentives to enable the commercialisation of aquaponics.
3. The promotion of aquaponics as social enterprise in urban areas.
4. The promotion of aquaponics in the developing world and in refugee camps.
5. The development of EU-wide aquaponics legislation and planning guidance.
6. The development of aquaponics training courses in order to provide the necessary skilled workforce to enable aquaponics to expand in the EU.
7. The development of stricter health and safety protocols, including fish welfare.
8. The establishment of an EU Aquaponics Association, in order to promote aquaponics and aquaponics technology in the EU and to assist with knowledge transfer, and the promotion of high production and produce standards in EU aquaponics (Fig. 1).

The assembled knowledge and experience of the group is considerable, and it is therefore appropriate to take the opportunity at the end of the 4-year COST project to gather this into a book, which was originally proposed by Benz Kotzen and Gavin M. Burnell at the start and then with Simon Goddek and Alyssa Joyce. We are fortunate that Springer Nature particularly Alexandrine Cheronet has been enthusiastic about this publication and that the COST organisation has funded the book as open access so that it is available for anyone to download. We see it as part of our duty to ensure that as many people as possible can benefit from the knowledge and expertise. The book is the product of 68 researchers and practitioners from 29 countries (Australia, Austria, Belgium, Brazil, Croatia, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Israel, Italy, Malta, the



**Fig. 1** Group picture of the COST group in Murcia, Spain, 2017

Netherlands, North Macedonia, Norway, Portugal, Serbia, Slovenia, South Africa, Spain, Sweden, Switzerland, Turkey, the United Kingdom, and the United States). When asking the members of our COST Action as well as external experts whether they were willing to contribute to this book, the response was overwhelming. Putting a book together with 24 chapters within 1 year would not have been possible without the cooperative spirit of every single lead author and coauthor. The book is testament to their knowledge and enthusiasm. We offer our warmest appreciation to our scientific review committee including Ranka Junge (aquaponics and education), Lidia Robaina (fish feed), Ragnheidur Thorarinsdottir (commercial aquaponics), Harry Palm (aquaponics and aquaculture systems), Morris Villarroel (fish welfare), Haissam Jijakli (plant pathology), Amit Gross (aquaculture and recycling), Dieter Anseeuw (hydroponics), and Charlie Shultz (aquaponics). We would also like to thank all peer reviewers of the 24 chapters who improved the content of the chapters. Finally, yet importantly, the editors would also like to thank their families and partners who have been patient in the editing a large book such as this.

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