16th International Scientific Conference on
Energy and Climate Change

''DUNAREA DE JOS" UNIVERSITY OF GALATI

Faculty of Automation, Computers, Electrical Engineering and Electronics

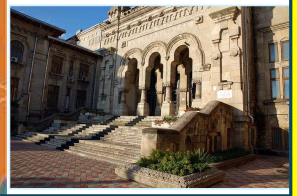
Embracing the aquaponic systems as a viable option for the future of agriculture

Ciprian VLAD
Lorena DEDIU
Cristian Victor LUNGU

Athens, 11th October, 2024

The city of Galați is located in the Southeast Region of Romania

300 km to Bran - Dracula's Castle



70 km to Danube Delta

80 km to Black Sea

150 km to Carpatians Montains

240 km to Bucharest City

300 km to Monasteries of Bucovina

UNIVERSITAS GALATIENSIS

Galați City

- documentary attested in 1445
- port town on the Danube River
- 304.340 residents (2016)
- 246.4 km^2
- continental climate, 4 distinct seasons

http://www.invest-in-galati.ro/en/informations

“Dunărea de Jos” University of Galați is the most important institution of higher education in the South-East of Romania

The history of higher education in Galați :

- 1948: establishment of the Land Improvement Institute;
- 1951: establishment of the Naval-Mechanical Institute;
- 1953: merging of the Naval-Mechanical Institute with the Agronomic Institute, and with the Fish Farming and Fishing Institute (transferred from other university centers), and the establishment of the Technical Institute in Galați;
- 1955: merging of the Technical Institute with the Food Industry Institute in Bucharest;
- 1957: transforming the Technical Institute into the Polytechnic Institute;
- 1959: establishment of the Pedagogic Institute and relocation of the Land Improvement Institute to Iași;
- 1974: establishment of the University of Galați by merging the Polytechnic Institute with the Pedagogic Institute (State Council Decree of 20 March 1974);
- 1991: the University of Galați becomes “Dunărea de Jos” University of Galați (Government Decision of 4 January 1991).

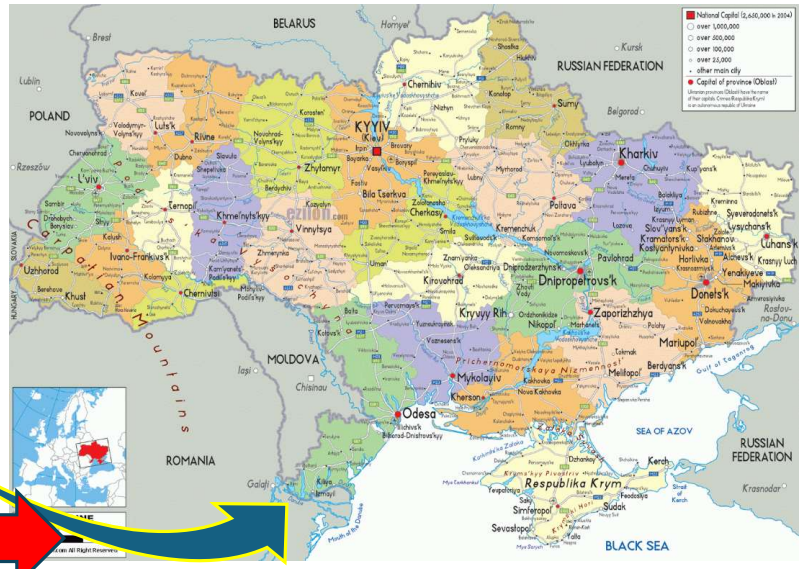
In the structure of the above mentioned institutes, there were a series of study programmes that were unique in the country: Naval Constructions, Harbors and Ship Exploitation, Food Industry, Fish Farming Technology, Cooling Devices – which meant that an important creation process on elaborating educational curricula and syllabi, lectures, laboratory equipment etc., presently being used in other university centers around the country, was fully the work of the academics in Galati higher education.

"Dunărea de Jos" University of Galati - European university with extensions oitside of Romania, in Western and Eastern Europe

Extension of the Faculty of Medicine and Pharmacy in Enna, Sicilia, Italy
Cross-Border Faculty - Extensions in Cahul, Comrat and Chisinau, Republic of Moldova
Cross-Border Faculty – Extension in Ismail, Ukraine

Extenssions to Cahul, Comrat and Chișinau, Republic of Moldova

Extenssion to Sicily, Italy



Extenssion to Ismail, Ukraine

"Dunarea de Jos" University of Galati
State higher education institution

- **over than 18,000 students**
  - more than 3,000 international students
- 746 academic personnel
- 14 faculties/74 departments
  - 71 Bachelor study programmes
  - 41 Master's study programmes
  - 4 Schools for Doctoral Studies
  - 16 Doctoral study programmes
    - 349 doctoral students

14 Faculties

Faculty of Engineering
Faculty of Naval Architecture
Faculty of Food Science and Engineering
Faculty of Automation, Computer Sciences, Electronics and Electrical Engineering
Faculty of Physical Education and Sports
Faculty of Letters
Faculty of Sciences and Environment
Faculty of History, Philosophy and Theology
Faculty of Engineering and Agronomy in Braila
Faculty of Economics and Business Administration
Faculty of Law and Administrative Sciences
Faculty of Medicine and Pharmacy
Faculty of Arts
Cross-Border Faculty

RDI&TT

35 Research Units

EERIS
Engage in the European Research Infrastructures System

BQ CERT ISO 9001 S/N : C00120

REFORM
research forms better

Regional Center for the Promotion of Industrial Property

INNOVATIVE RESEARCH CONSORTIUMS

- Regional Innovation Consortium for the South-East Development Region
- Danube - Center for Digital Innovation in the South East Region

COMPETITIVENESS POLE

- IND-AGRO-POL

11 INNOVATIVE CLUSTER ASSOCIATIONS

Over 150 annual scientific events

Over 30 million euros in annual research funding

Research Barometer

Clarivate Analytics

Ciprian Vlad – Associate Professor PhD. Eng.

- 2012 -2020 - President of Ethics Commission within Dunarea de Jos University of Galati
- 2013, 2015-2020 – Organizer of the University Admission
- 2020-2024 – Vice-rector with University strategies and partnership with students

- Research focus on renewable energy system and their control
  - h-index 5, 70 citations in ISI articles
  - Web of Science ResearcherID: https://publons.com/researcher/C-6212-2012/
  - ORCID: https://orcid.org/0000-0003-2545-3391

Content

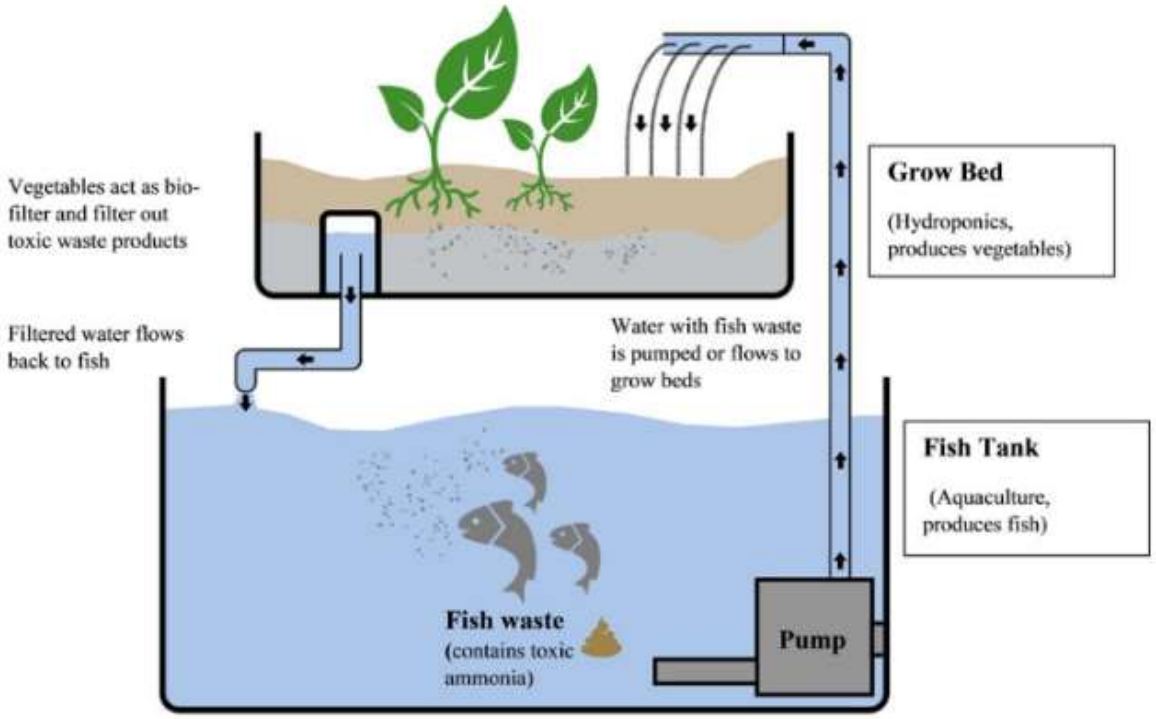


Figure.1 Diagram of an aquaponics system

- ✓ Aquaponics is a symbiotic system where fish and plants grow together in a connected environment.
- ✓ Fish waste provides essential nutrients for plant growth, and plants naturally filter and clean the water for the fish. This closed-loop system significantly reduces water usage and eliminates the need for chemical fertilizers, making it an eco-friendly farming method.

- ✓ Nowadays, after reviewing all database from web of science there are 1881 documents regarding aquaponics field and 1118 since 2020.

- ✓ Governments and organizations worldwide are recognizing the potential of aquaponics and are beginning to support its development through funding, research initiatives, and policy frameworks.

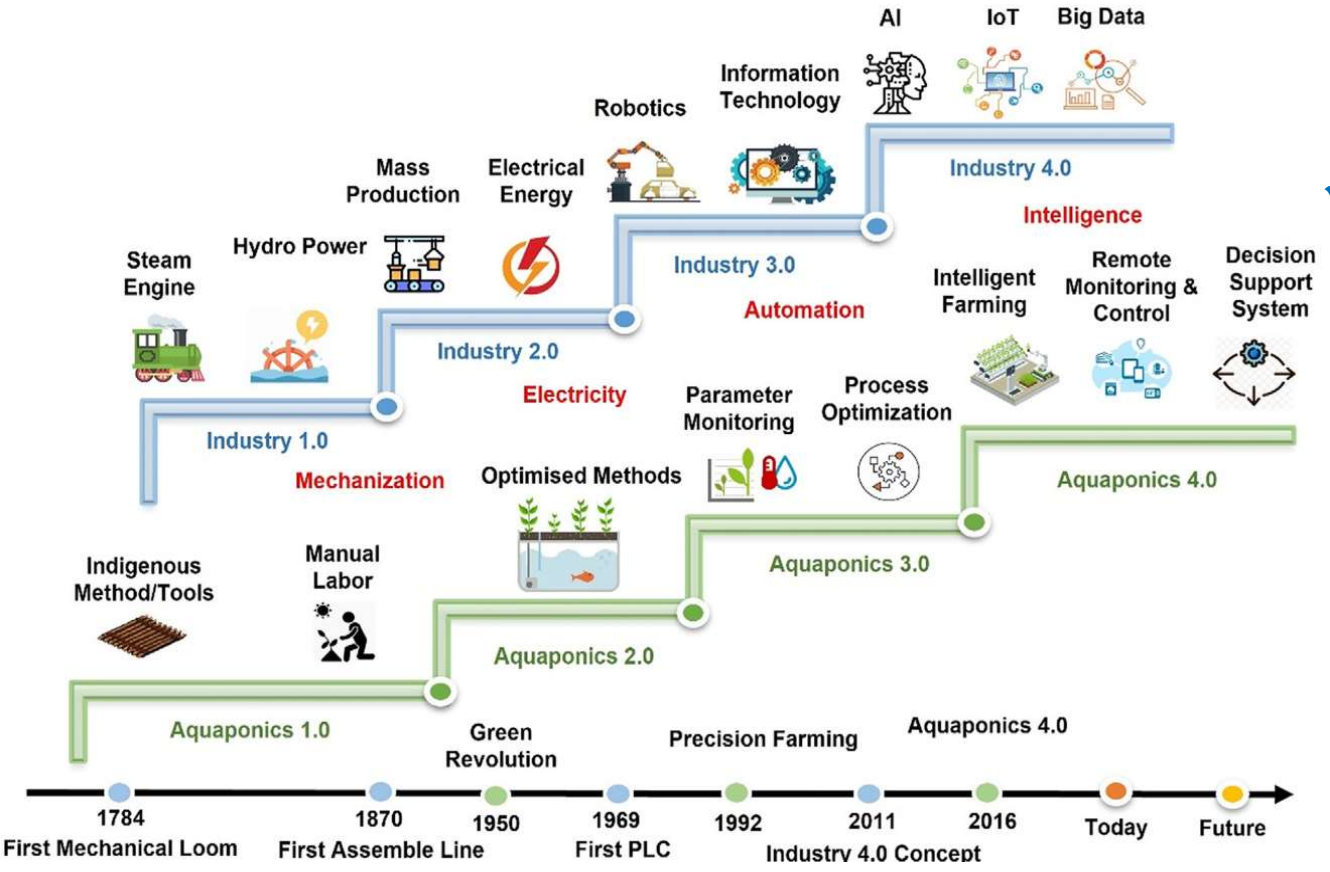
Types of aquaponics systems

(a) media based
(b) floating rafts based
(c) nutrient film technique
(d) vertical towers
(e) wicking beds
(f) dutch bucket

Figure.2 Example aquaponics system

- ✓ Development of the aquaculture sector in Romania in the 1970s, with peak production of 50,680 tons of fish by the late 1980s.
- ✓ Impact of the political transition in the 1990s and the relaunch of the sector from 2001 through European funding.
- ✓ First dedicated aquaponics project at Dunărea de Jos University, Galați (2006-2007).
- ✓ International collaborations through projects like AQUA-ROM, supported by Swiss grants, aiming to increase income and improve health in disadvantaged areas.
- ✓ A big challenge is the lack of standardization in growth technologies and financial risks involved.

Technologial advancements in aquaponics



Aquaponics 2.0

- ✓ Research on system optimization and integration of fish species with various plant crops.
- ✓ Research on the importance of system design and substrate choice for high-yield leafy greens.

Figure.3 Evolution of aquaponics systems with industry

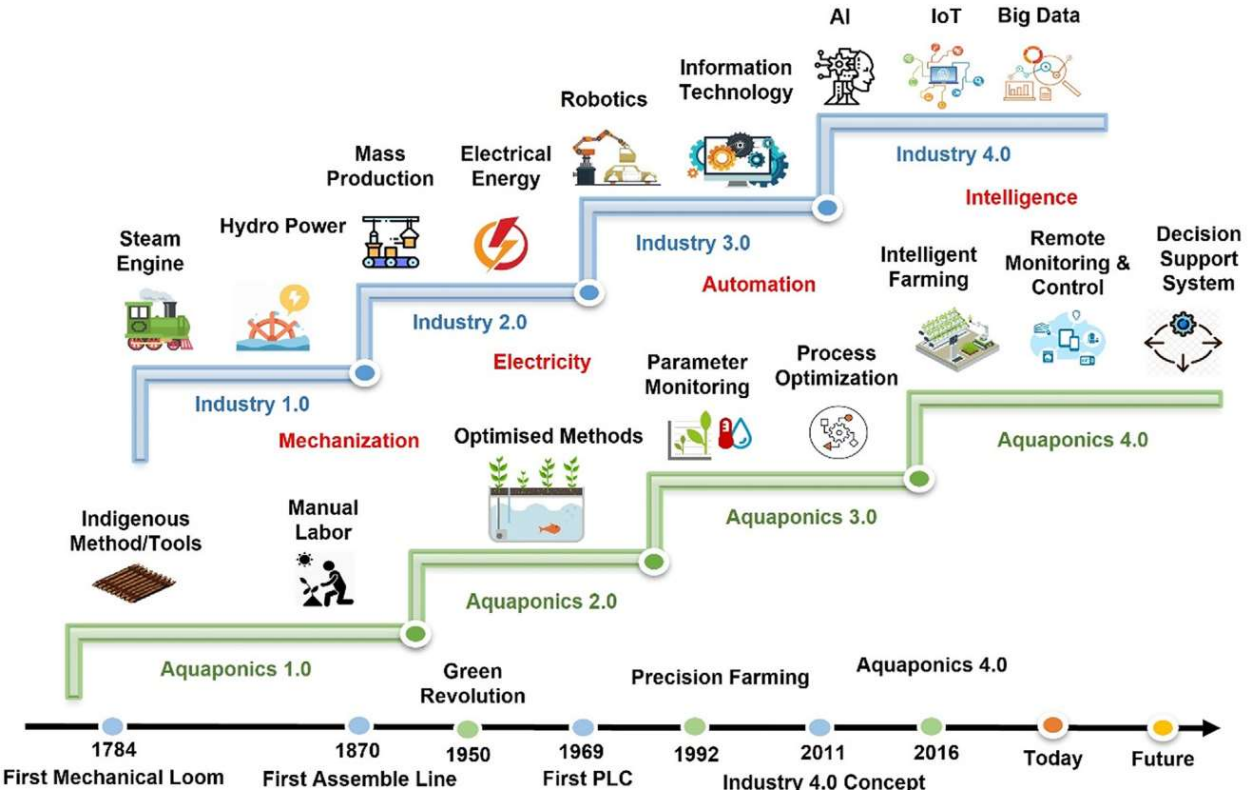


Figure.3 Evolution of aquaponics systems with industry

Aquaponics 3.0

- ✓ Studies on maintaining optimal nutrient levels and microbial populations.
- ✓ Advanced filtration systems and automated feeding mechanisms.

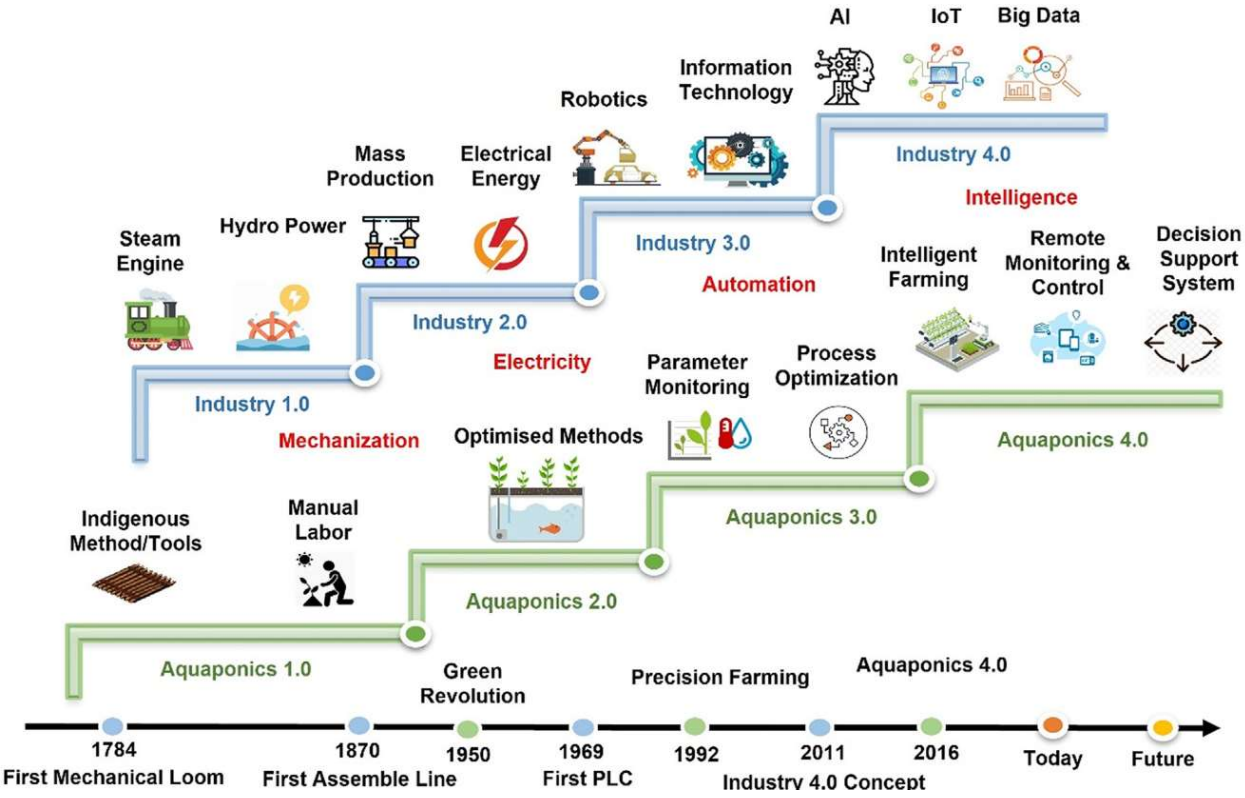


Figure.3 Evolution of aquaponics systems with industry

Aquaponics 4.0

- ✓ Integration of Artificial Intelligence (AI) to optimize growth conditions in real-time.
- ✓ Internet of Things (IoT) for monitoring and automated adjustments in aquaponic systems.

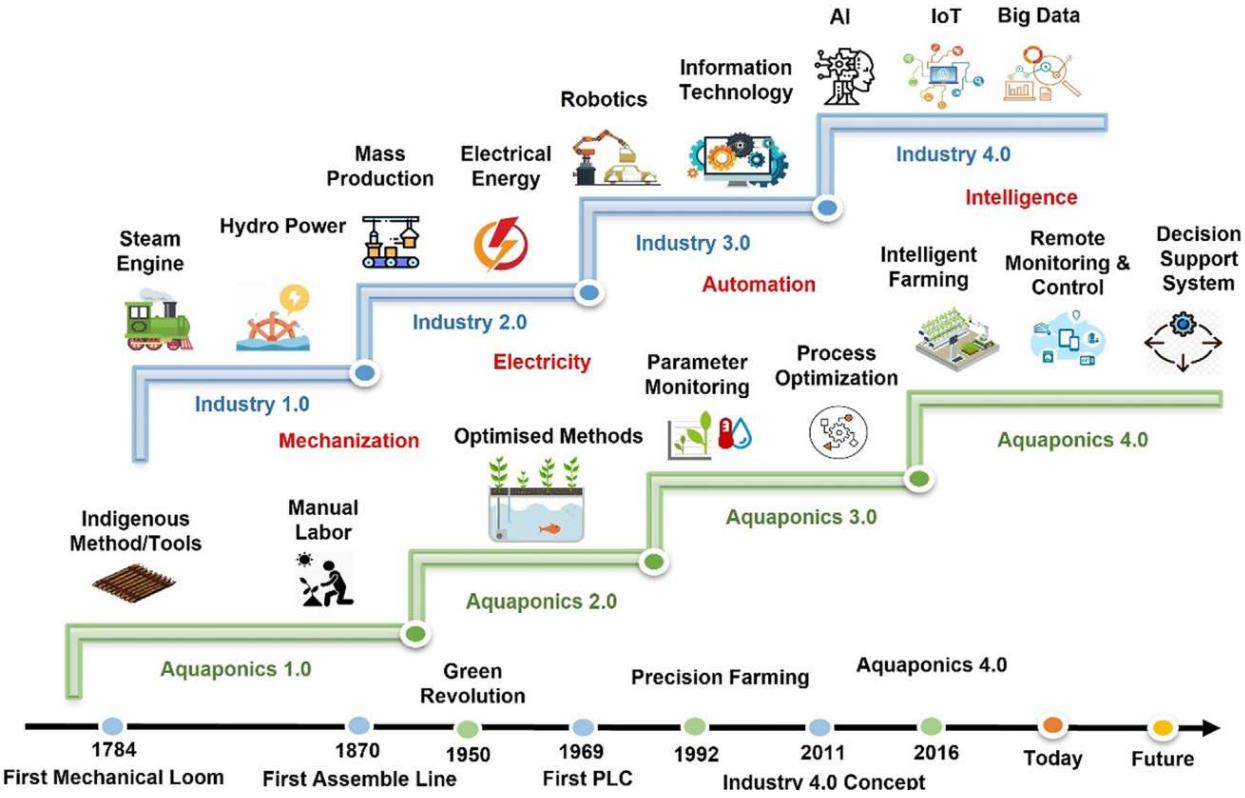


Figure.3 Evolution of aquaponics systems with industry

Aquaponics 4.0

- ✓ Use of renewable energy (solar, wind, biogas) to power aquaponic systems.
- ✓ HOMER Energy software to implement renewable energy sources and conduct economic analysis.

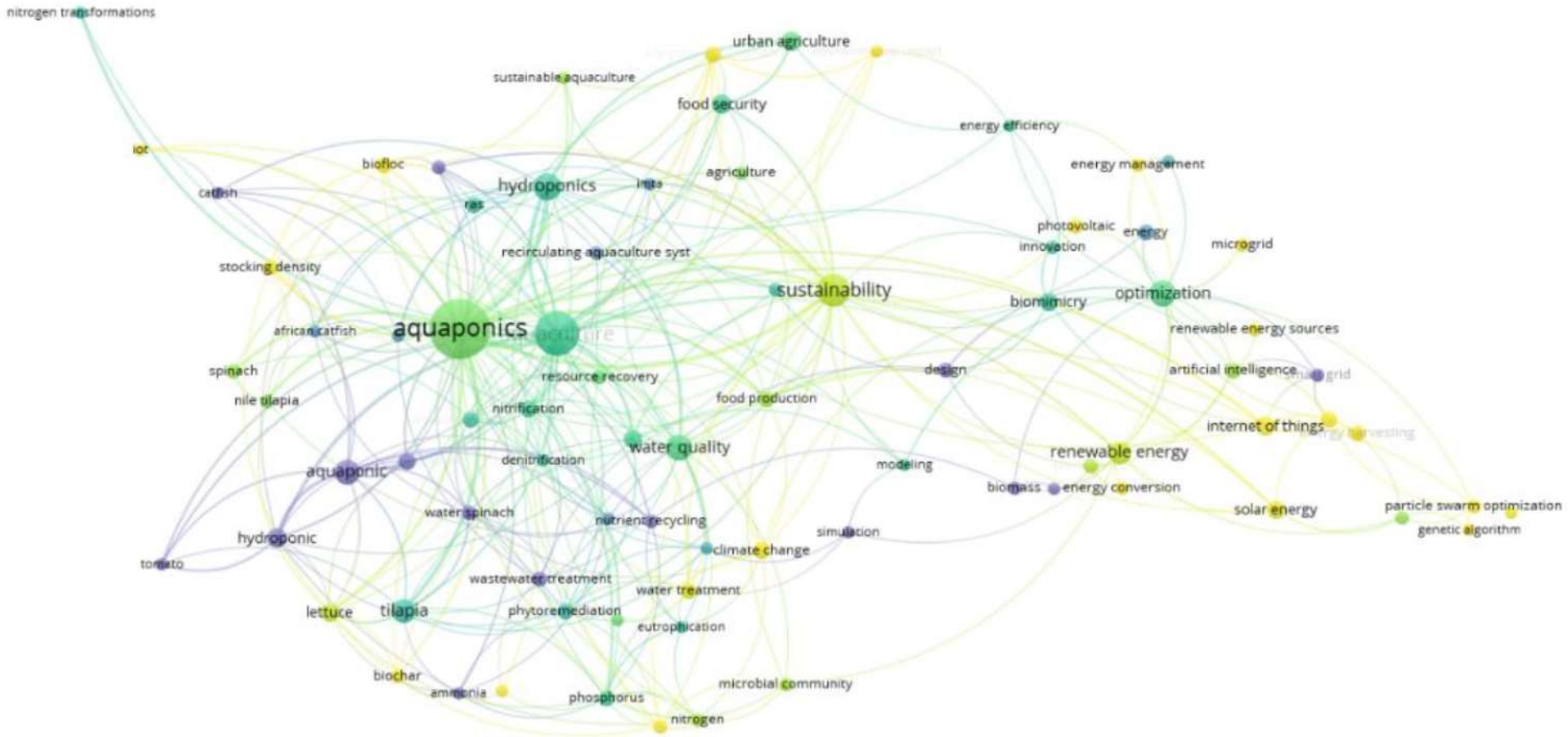


Figure.4 Overlay visualization by the average publication year of main terms in aquaponics with sustainable energy and food generation

Figure.5 Example of rooftops aquaponics system

- ✓ Potential to transform unused urban spaces into productive agricultural sites.
- ✓ Reducing carbon footprint by decreasing the need for long-distance food transportation.

Conclusions

- ✓ Aquaponics combines the benefits of aquaculture and hydroponics, reducing water and resource use.
- ✓ Modern technologies, along with supportive policies, make aquaponics a viable solution to current food security and climate challenges.
- ✓ The future of aquaponics is promising, with growing adoption due to its ecological and technological benefits.

Thank you for time and undivided attention!

ciprian.vlad@ugal.ro