The Pharma Innovation Journal 2023; SP-12(9): 1150-1154

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2023; SP-12(9): 1150-1154

www.thepharmajournal.com
Received: 02-06-2023
Accepted: 07-07-2023

Tabaan Quamar
PG Research Scholar, Department of Aquaculture, School of Agriculture, Sanjeev Agrawal Global Educational (SAGE) University Bhopal, Madhya Pradesh, India

Rakhi Das
Assistant Professor, Department of Aquaculture, School of Agriculture, Sanjeev Agrawal Global Educational (SAGE) University Bhopal, Madhya Pradesh, India

Corresponding Author:
Tabaan Quamar
PG Research Scholar, Department of Aquaculture, School of Agriculture, Sanjeev Agrawal Global Educational (SAGE) University Bhopal, Madhya Pradesh, India

Production of organic vegetables through Aquaponics: A way forward to sustain local food plants growth

Tabaan Quamar and Rakhi Das

Abstract
Aquaponic systems can be a game-changer for organic food security through increased production capability in locally grown crops/plants and food sustainability, more beneficial in the reduction of water usage that is associated with traditional methods of inland aquaculture and horticulture. The gradual and steady adoption aquaponics as a path to attain food sustainability had quickly proliferated over the past few years or so throughout the globe promoting it as an innovative, scalable, environmentally friendly technology in aquaculture and other allied sectors. Aquaponics has insofar proven as a viable option of food production in a sustainable and resource-efficient largely avoiding negative impact on the environment.

Keywords: sustainable, economics, hunger, food security, production

Introduction
Due to rapid population explosion throughout the world, today, more than half the entire population of the world had been facing food scarcity, and as per the current statistics more than one in every five children under the age of five being malnourished and showing signs of stunted growth. Our existing food production systems so far have failed to meet the desired demands, and the COVID-19 pandemic has made things worse. This has resulted in the food industry globally leaning towards a more sustainable and accessible system for the production of healthy food, in particular fresh vegetables and fruits. New farming techniques such as hydroponics and aquaponics that gives maximum yield with minimal resource utilization, specifically that of (space, soil and water) emerged as the best candidates to alleviate this problem if not fully at least to a maximum possible extent. Amongst the other viable options explored, aquaponics stood out as the most innovative food production method that involved farming of fish and other aquatic animals and plants–mostly vegetables and herbs together in either a coupled (closed-loop) or decoupled systems (run-off). In a coupled aquaponic system, the waste from the fish is converted by bacteria that naturally thrive in the water into nutrients for the plants, which absorb them, thus cleaning the water for the fish and thereby forming a full recirculation cycle. Due to its scalable and integrative character, aquaponics is a complex food production technology that can address the 3 columns of sustainability that is environmental factor, economic and social factor.
From the standpoint of sustainability, the advantages that outweigh the constraints of aquaponics as one of the most preferred methods of farming are most notably: low water usage, little to no chemical usage, no use of synthetic fertilisers or pesticides, and waste water recycling, the latter presenting a potential solution to the environmental problems caused by eutrophication of both natural and man-made aquatic ecosystems.
The organic farming when we discuss about on grassroots level that started in the early twentieth century gathered strength in acceptance mostly in response to the increasingly intensive cultivation methods and the creation of synthetic and cheapo fertilizer usage that spiralled out of control within a short span spoiling the natural ecological balance. Organic farming in agriculture pioneers concentrated on discovering a more natural and eco-friendly elucidation to improve and preserve the health condition of soil profile and environmentally stable methodology of farming. This movement grew and spread widely in science 1970s its more popular became concerned about itself health status and the health of the atmosphere and in the year of 1980s as well as 1990s, assembly and feeding increasingly showed an increasing pattern.

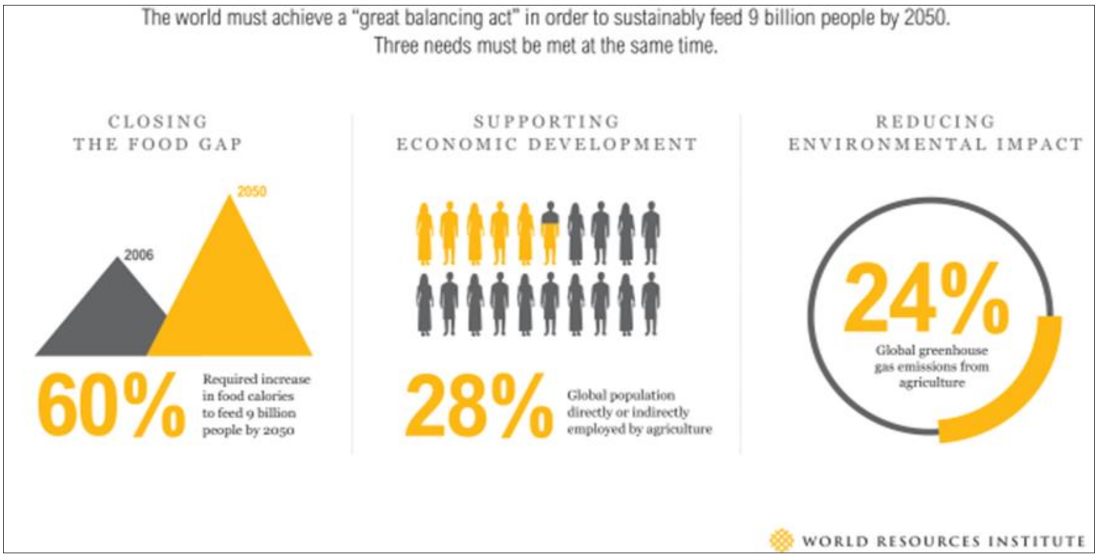

Fig 1: The great balancing act

In resent time organic farming practices has dispersed worldwide underwrites to answering the world-wide encounters of agriculture-based/aquaculture based food production systems which were earlier overlooked and forgotten to due rapid familiarization of synthetic fertilizers and supplements that were promoted largely by corporate conglomerates as the go to solution for the ever increasing demand for fresh vegetable and fish production thereby closing the curtain on the tried and tested methods of aquaponics and hydroponics. Little did anyone notice, measure or predict the detrimental effects this would have on the future health of general population and the environment as a whole. Furthermore, there were no strict health and environmental protection laws imposed by the governing bodies like today, where every nation on the planet now is contributing to common global initiatives like save the planet, and better health- better environment for all movement.

Materials and Methods

Here we discuss about few widely practised methods

Aquaponics layout: Aquaponics systems can be constructed based on several types of bed layout and media by following different methods, and the selection of a particular system depends mostly on the following factors such as the geographical location, availability of infrastructure, selection of crop and selection of fish species. Essentially, the classification is as follows: nutrient film technique (NFT), floating raft or deep water culture (DWC), and media-filled technique also known as grow bed method.

The nutrient film technique (NFT).

This method has proven to be most beneficial for consideration of vegetable plants with diffident size with limited root structure. This method has a proven capability of supplying ample amount of dissolved oxygen, which ultimately ensures the high productivity of the vegetables. Because large root systems clog the device's recirculating mechanism, only small plants are recommended. To avoid blockade of system, solid debris should be removed as efficiently as possible. To remove solid particles, the system should be assisted by a biofilter and a sedimentation tank.

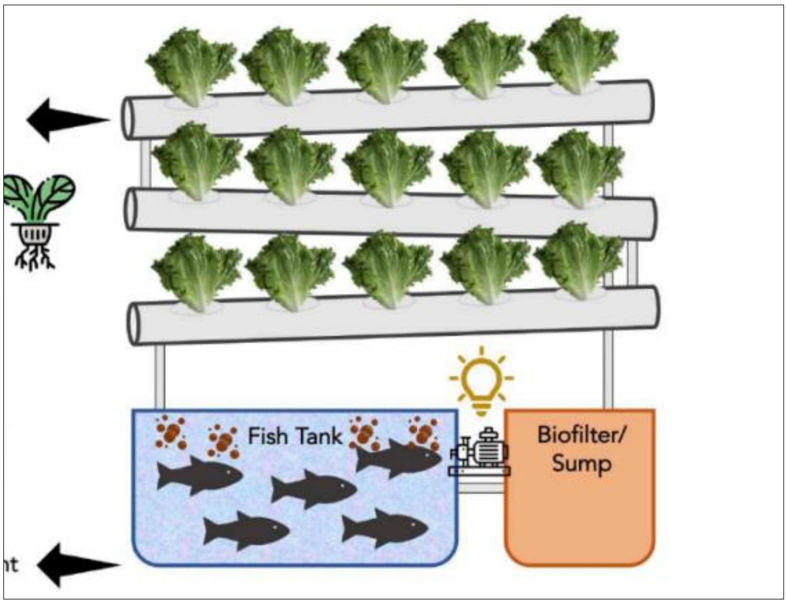

Fig 2: Nutrient film Technique (NFT)

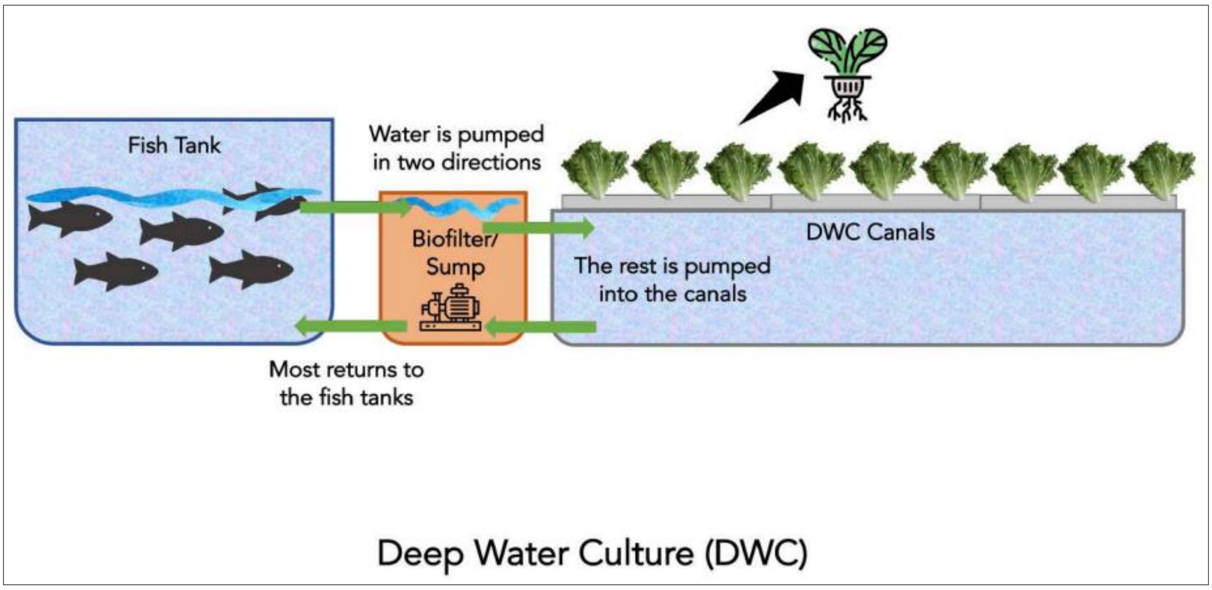

Fig 3: The floating raft technique/Deep water culture (DWC)

The plant's roots are allowed to dangle and grow freely for adequate nutrient uptake from the water. The water channel does not become clogged throughout this operation. This system should include a nitrification device for optimal and predicted production.

The media-filled method

In this system the tank filled with media or a substrate that allows for growth of naturally occurring bacteria to grow that promotes nitrification, no biofilters are required in media-based beds. An auto-siphon is used to generate direct contact between plant roots and air as the auto-siphon is set in a way such that it mimics a natural flood and drain cycle in which during the drain phase of the cycle the entire filled up water in the bed is drained out with high pressure facilitating adequate amount of oxygen being pulled from the media surface passing through the roots Despite its advantages, clogging and oxygen deficiency are key issues in this aquaponics system as this system is highly used for water-loving and hardy plants that has extensive root growth..

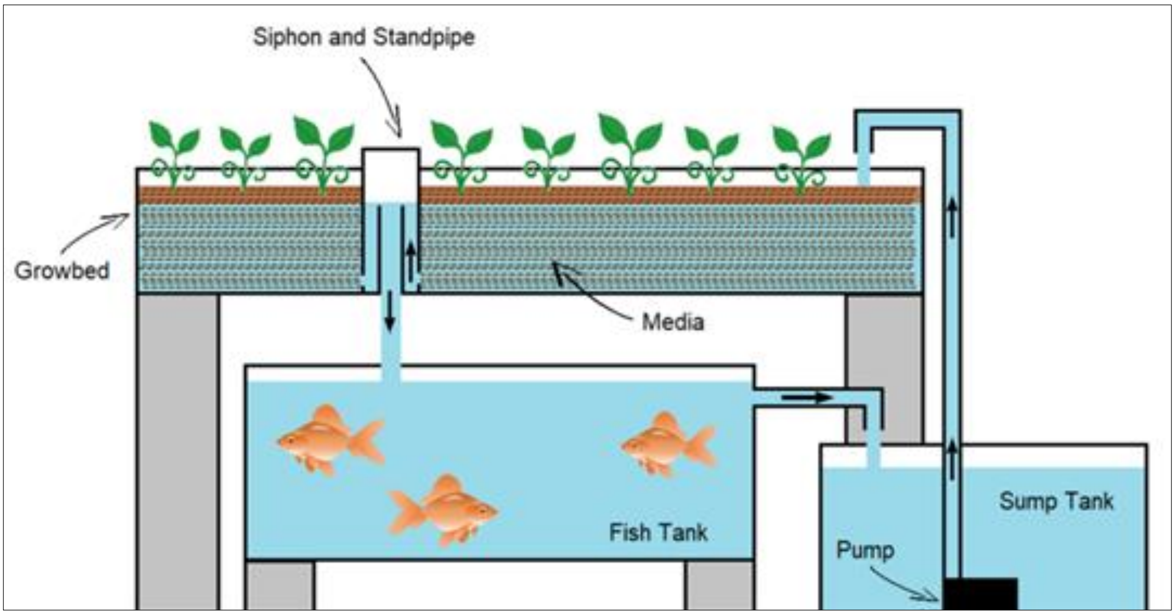

Fig 4: Despite its advantages, clogging and oxygen deficiency are key issues in this aquaponics system as this system is highly used for water-loving and hardy plants that has extensive root growth

Experiment plant Curly Kale (Brassica oleracea var. *acephala*): Kale plays a very important role regarding nutrients level. Kale is having wellness and immunity boosting power, detoxifies the liver, promotes skin and hair health and maintains eye health. Kale is a rich source of fiber with plenty of antioxidants, rich in vitamin A, C and K, and high in protein. The sprouts of the vegetable are regularly spread on the moving raft (*Styrofoam material*) at an even space of near 2 cm amongst every plant in together sides (Fig. 5). A net pot is used to grow each plant seedling, allowing the plant root to be submerged in the water throughout the grow bed under each floating raft to allow for ample nutrient uptake by the roots. The floating raft of each tank contained 1728 net pots of plant. Overall, 6912 net pots are placed every ringing a plant sprout that was thought on moving rafts in the deep-water culture system.

Fig 5: Deep Water Culture Aquaponic Farm

Results

This attempted has been made to emulate the combine's vegetable like kale (*Brassica oleracea* var. Acephala) (Fig. 6) with Nile tilapia (*Oreochromis niloticus*) in the aquaponic system. The trial was conducted for 3 months period. The growth parameters of Nile tilapia and total yield of curly kale were assessed, water necessity was resolute. The WQP (water quality parameters) state in an aquaponic system mixed amongst 2.6 percent and 3.4 percent of total water capacity in the system. The manifestation of mechanical and biological screens in the aquaponic system, WQP (water quality parameters) was capable for fish evolution. The aquaponic system did skill numerous bottlenecks escapable by the accumulation of a mechanical filter as well as damp and moist form everywhere the grow bed potency lead to spawning of plant diseases/infections especially around the summer season. Uniform still recirculation was unbroken in the aquaponics system; water quality was not proficient for kale development. Vegetable growing rate at the establishment of the trial was low due to lack of oxygen inside the deep water culture channels. Therefore, plant quality was low. When water quality condition was bad plant quality showed significant signs of nutrient deficiency. The study reveals that sustainable plant growth depends on water quality and shows the way for possibility of organic farming along with fishery. A few plants that can perform well in an aquaponic system is mentioned below.

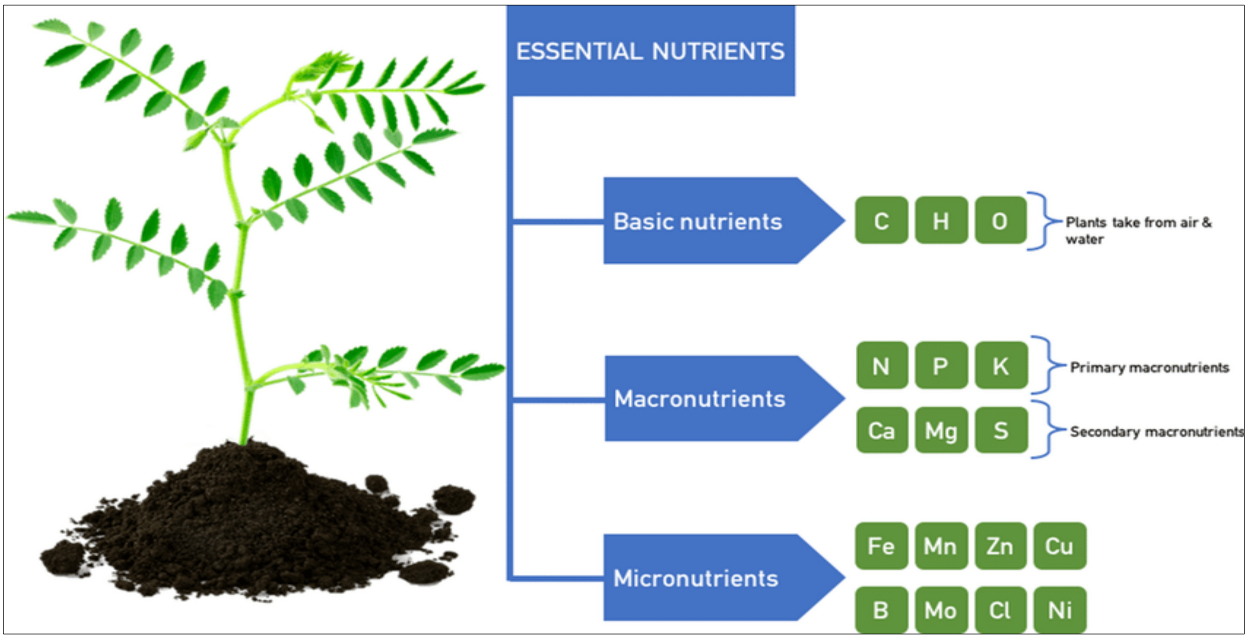

Fig 6: Curly Kale Leaf

Suitable plants for Aquaponics: Aquaponics has recently become popular for developing a widespread variety of crops including agronomic as well as horticultural crops. In aquaponics, on the other hand, is largely concerned with the making of agricultural crops such as fruitlets and vegetables. This method mostly grows fruitlets with joggers and gulls, as well as crawling or climbing plants. Strawberry, cantaloupe, tomatoes, watermelon, and dwarf citrus tree are among the primary fruits, while vegetables include lettuce, onion, beans, beets, squash, radish, zucchini, asparagus, broccoli, bell peppers, cucumbers, Swiss chard, peas, carrots, spinach, and others. Correspondingly, decorative plants such as basil, orchid, tulip, thyme, cilantro, pansy, sage, aloe vera, lemongrass, violas, wheatgrass, grafted rose, oregano, parsley, and others are formed expansively in aquaponics. In this method, cereals such as sweet corn are also widely farmed.

Plant nutrition requirements

Plants require macronutrients and micronutrients for growth and development. Nitrogen, Potassium, and Phosphorus are the three most important nutrients for plants. Plants require macronutrients such as S, Mg, Ca, O, C, H, N, P, K, and micronutrients such as boron, chloride, copper, iron, manganese, molybdenum, nickel, and zinc for optimal growth and development.

Hydroponics solution supplied to the plants should contain the elements in the required proportions for improved plant yield. These are the fundamental structural components of amino acids, proteins, and nucleic acids. Plants primarily use nutrients in the ionic form and through the metabolism of amino acids. Carbon, Hydrogen, and Oxygen may be obtained directly from the outside air; but the remaining components must be tested on a regular basis to ensure the availability of these compounds is at an optimal level for growth and development. Additionally, because fish waste lacks iron content, it must be supplemented artificially for healthy plant growth.

Conclusions

Aquaponics is a good practice method to improve local organic food plant production to meet the daily needs of rapidly increasing population. Necessitated alteration/variations in water quality management can improve the growth of organic food plants to thrive and sustain. It is a simple and easily cultivatable method at individual home-level and helps to keep our environment pollution-free which leads to improved survival rate on our planet. This experiment proves that a much more focused effort towards continuous research, development and analysis is needed to streamline aquaponics further into a farmer – friendly viable option for the masses at large who at this space age are still struggling with the hurdles faced by going forward with traditional/ conventional methods of fish and Agri-farming. Furthermore, a focused and farmer-friendly approach was adopted by a large group of people in Kerala, Southern India, adopting a domesticated system on a community based approach, wherein the production was pooled at a central point of distribution of the produce very successfully, and thus far all the initiatives have proven their merit. This also shows the scalability of Aquaponics as a diverse and optimal methodology of growing food organically following a sustainable way farming with dual sector benefit as it includes both Aquaculture and Horticulture in combination.

Acknowledgements

The authors gratefully acknowledge the Dean School of Agriculture, and Vice Chancellor Sanjeev Agrawal Global Educational (SAGE) University Bhopal, MP, for providing the Necessary facilities for conducting this research work.

Reference

1. Ackerman K, Conard M, Culligan P, Plunz R, Sutto MP, Whit-tinghill L. Sustainable food systems for future cities: the potential of urban agriculture. Economic and Social Review. 2014;45(2):189-206.
2. Engle CR. Economics of Aquaponics. SR AC Publisher. Aquaculture Center; c2015.
3. Fruscella L, Kotzen B, Milliken S. Organic aquaponics in the European Union: towards sustainable farming practices in the framework of the new EU regulation. Rev. Aquacult. 2021;13:1661-1682. https://doi.org/10.1111/raq.12539.
4. Konig B, Janker J, Reinhardt T, Villarroel M, Junge R. Analysis of aquaponics as an emerging technological innovation system. Journal of Cleaner Production. 2018;180:232-243.
5. Pratt CW, Cornely K. Essential Biochemistry. 3rd edition. Edited by John Wiley and sons; c2014.
6. Rakocy JE, Shultz RC, Ailey BDS, Thoman ES. Aquaponic production of tilapia and basil: Comparing a batch and staggered cropping system. Acta Horticulture. 2004;648:63-69.
7. Resh HM. Hydroponic Food Production: A Definitive Guidebook for the Advanced Home Gardener and the Commercial Hydroponic Grower (CRC Press); c2012.
8. Somerville C, Cohen M, Pantanella E, Stankus A, Lovatelli A. Small-scale aquaponic food production. FAO Fisheries and Aquaculture Technical Paper. Paper number; c2014. p. 589.
9. Shah KK, Modi B, Lamsal B, Shrestha J, Aryal SP. Bioactive compounds in tomato and their roles in disease prevention. Fundamental and Applied Agriculture. 2021b;6(2):210-224.