

An Aquaponic System And A Method Of Arranging Beds Of A Plurality Of Frames Of The Aquaponic System

Technical Field

[0001] The present invention relates to an aquaponic system and a method of arranging beds of a plurality of frames of an aquaponic system.

Background

[0002] Traditional agriculture system is inefficient and labour intensive. One of the factors is “cost of access”, which is the time required to get to the crops. For example, a worker may be walking down rows of crops, bending over for seeding, weeding, or harvesting the crop. Conventional aquaponic system has also a high cost of access. For example, the worker would need to spend time walking, retrieving growing channels, checking the crops, etc.

[0003] Further, land-based recycle aquaculture facilities may pollute the environment. For example, land-based aquaculture releases dissolved nitrogen and phosphorus to the water environment, which contributes to the undesirable growth of macro and micro algae in receiving waters. In land-based aquaculture, water quality can be controlled by a high rate of either water exchange, which is costly; or water treatment and subsequent recirculation, which comes at a price. To offset treatment costs, the integration of aquaculture and plants offers an ideal solution to reduce nutrients discharge levels, increase profitability, and convert the excretion of aquatic animal, e.g. fish, into beneficial products.

[0004] Aquaponic system is a food production system that uses both an aquaculture system for rearing aquatic animal and a hydroponic system for cultivating plants. Aquaponic can provide answers to many of the above-mentioned problems. Aquaponics, the combined culture of aquatic animal and crops in recirculating systems, has become increasingly popular. Essentially, the excretion from the aquatic animal may be converted into fertilizer and channelled to the crops and the water from the crops is cleaned and safe to be return back to the aquatic animal. Aquaponic system offers several benefits. Dissolved waste nutrients are recovered by the plants, reducing discharge to the environment and extending water use (i.e.,

by removing dissolved nutrients through plant uptake, the water exchange rate can be reduced). Minimizing water exchange reduces the costs of operating aquaponic systems in arid climates and heated greenhouses where water or heated water is a significant expense.

[0005] At its highest level, aquaponics is a technology-intensive, capital-intensive and knowledge-intensive method of food production that is discerned based on definitions such as horizontal vs. vertical, and open vs. recirculating. Systems are characterized according to the way plants are supplied with nutrient solutions in the hydroponic systems, e.g., floating polystyrene foam sheets (floating raft), nutrient film technique (NFT), or media filled growth beds arranged horizontally or vertically, while aquatic animals are kept in standard recirculating aquaculture conditions. Aquaponic technology is considered to be ecologically friendly: it uses renewable resources with a very high efficacy as indicated by near zero-waste discharge.

[0006] While the aquaponic system has many benefits, the conventional system is still inefficient and labour intensive and has a high cost of access.

[0007] Therefore, it would be advantageous to improve on the conventional system to address the abovementioned problems.

Summary

[0008] According to various embodiments, an aquaponic system is provided. Aquaponic system includes a hydroponic system disposed above and in fluid communication with an aquaculture system. The hydroponic system includes a plurality of frames arranged in a vertical direction and spaced apart from each other at a pre-determined spacing, such that the plurality of frames are adapted to allow light therethrough, such that each of the plurality of frames includes a length extending in a longitudinal direction perpendicular to the vertical direction and a width extending in a lateral direction perpendicular to the vertical direction and the longitudinal direction, such that each of the plurality of frames includes a bed having a length extending in the longitudinal direction and slidably attached to the each of the plurality of frames and adapted to slide along the width of the each of the plurality of frames, such that the

bed is adapted to hold crops and fluidly connected to the aquaculture system, and a platform for supporting a user and adapted to travel to the plurality of frames in the vertical direction.

[0009] According to various embodiments, the bed may include a plurality of elongated holders adapted to hold crops, such that the plurality of elongated holders extend in the longitudinal direction and are spaced apart from each other.

[0010] According to various embodiments, the plurality of frames are sectioned into an upper section of frames and a lower section of frames below the upper section, such that the plurality of elongated holders at the upper section are spaced further apart from each other than the plurality of elongated holders at the lower section.

[0011] According to various embodiments, each of the plurality of elongated holders may include a tube comprising a plurality of openings arranged along the tube.

[0012] According to various embodiments, the beds in the plurality of frames may be arranged in a staggered configuration, such that the beds are able to receive direct sunlight.

[0013] According to various embodiments, each of the plurality of frames may include a near side adjacent the platform and a far side opposite the near side, such that the bed may be adapted to move to and from the near side and the far side, such that the bed is configured to be positioned at the near side when the crops are ready to be harvested.

[0014] According to various embodiments, the bed may include a width in the range of 0.6m to 1m.

[0015] According to various embodiments, the aquaponic system may further include a light-permeable cover attached the bed, such that the cover extends across the width of the bed and along the length of the bed to form an enclosure adapted to enclose the crops therein.

[0016] According to various embodiments, the aquaponic system may further include a light source disposed under one or more of the plurality of frames and adapted to emit light onto the crops held by a bed thereunder.

[0017] According to various embodiments, the pre-determined spacing between any two of the plurality of frames may be adjustable.

[0018] According to various embodiments, the platform may extend up to the length of the plurality of frames.

[0019] According to various embodiments, an aquaponic system is provided. The aquaponic system includes a hydroponic system disposed above and in fluid communication with an aquaculture system, the hydroponic system includes a plurality of frames arranged in a vertical direction and spaced apart from each other at a pre-determined spacing, such that the plurality of frames are adapted to allow light therethrough, such that each of the plurality of frames includes a length extending in a longitudinal direction perpendicular to the vertical direction and a width extending in a lateral direction perpendicular to the vertical direction and the longitudinal direction, such that each of the plurality of frames includes a bed having a length extending in the longitudinal direction and slidably attached to the each of the plurality of frames and adapted to slide along the width of the each of the plurality of frames, such that the bed is adapted to hold crops and fluidly connected to the aquaculture system, a platform for supporting a user and adapted to travel to the plurality of frames in the vertical direction, a processor, a memory in communication with the processor for storing instruction executable by the processor, the processor configured to identify that the crops on a bed of a frame of the plurality of frames is ready to be harvested based on crop data, move the identified bed to adjacent the platform for the crops to be harvested, and stagger the beds of a remaining plurality of frames below the frame to receive optimal direct sunlight.

[0020] According to various embodiments, a method of arranging beds of a plurality of frames of an aquaponic system according to the above embodiment is provided. The method includes identifying that the crops on a bed of a frame of the plurality of frames is ready to be harvested based on crop data, moving the identified bed to adjacent the platform for the crops to be harvested, and staggering the beds of a remaining plurality of frames below the frame to receive optimal direct sunlight.

Brief Description of Drawings

[0021] Fig. 1 shows a schematic diagram of an exemplary embodiment of an aquaponic system.

[0022] Fig. 2 shows a perspective view of an exemplary embodiment of the bed.

[0023] Fig. 3 shows a side view of the embodiment of the hydroponic system in Fig. 1.

[0024] Fig. 3A shows an exemplary embodiment of the aquaculture system.

[0025] Fig. 4 shows an exemplary embodiment of a controller system configured to control the operation of the aquaponic system.

[0026] Fig. 5 shows a flow diagram of an exemplary method of arranging beds of a plurality of frames.

Detailed Description

[0027] Fig. 1 shows a schematic diagram of an exemplary embodiment of an aquaponic system 10. Aquaponic system 10 includes a hydroponic system 100 disposed above and in fluid communication with an aquaculture system 12. Hydroponic system 100 includes a plurality of frames 110 arranged in a vertical direction 100V and spaced apart from each other at a pre-determined spacing 110S. Plurality of frames 110 are adapted to allow light therethrough. Each of the plurality of frames 110 includes a length extending in a longitudinal direction 100G (refer to Fig. 3) perpendicular to the vertical direction 100V and a width extending in a lateral direction 100T perpendicular to the vertical direction 100V and the longitudinal direction 100G. Each of the plurality of frames 110 includes a bed 120 having a length extending in the longitudinal direction 100G and slidably attached to the each of the plurality of frames 110 and adapted to slide along the width of the each of the plurality of frames 110. Bed 120 is adapted to hold crops and fluidly connected to the aquaculture system 12. Hydroponic system 100 includes a platform 130 for supporting a user and adapted to travel to the plurality of frames

110 in the vertical direction 100V. Aquaponic system 10 is able to maximize the number of users who can access the crops simultaneously and increase the speed and ease to access the crops. Consequently, the aquaponic system 10 is able to cut down “costs of access”, increase efficiency and optimize yield of the aquaponic system 10.

[0028] As shown in Fig. 1, the hydroponic system 100 may be disposed above the aquaculture system 12. This configuration has a relatively small footprint which saves floor space. This is an important advantage especially on land with limited space. Aquaponic system 10 may include a support structure 104 for supporting the plurality of frames 110. Platform 130 may be disposed adjacent the support structure 104 and adapted to ascend and descend in the vertical direction 100V to enable the user to access each of the plurality of frames 110. As shown in Fig. 1, the hydroponic system 100 may include two support structures 104, each supporting a plurality of frames 110. Platform 130 may be located between the two support structures 104 so that the user may be able to access the plurality of frames 110 on both sides of the platform 130. Further, it can be appreciated that the hydroponic system 100 may include two or more support structures 104 and are accessible by the platform 130. For example, the hydroponic system 100 may include four support structures 104 extending along the sides of a quadrilateral platform 130, each of the support structures 104 supporting a plurality of frames 110. Support structure 104 may be up to 15m high, e.g. 5m, 10m, 13m. As the hydroponic system 100 is built on top of the aquaculture system 12, the structure, i.e. support structure 104, plurality of frames 110, beds 120, pipes, etc. should be lightweight and easily accessible to be operated manually or automatically. Hydroponic system 100 may be scalable and portable to be used in any part of the world and yet work effectively and efficiently. Plurality of frames 110 may be made of steel, fibreglass and aluminium, etc. Support structure 104 may be frames that allow sunlight to pass therethrough so that sunlight can reach the lower section of the plurality of frames 110.

[0029] Each of the plurality of frames 110 includes a bed 120 adapted to move along the width of the frame 110 as shown by the broken lined arrows in the lateral direction 100T. Each of the plurality of frames 110 has a near side 110N adjacent the platform 130 and a far side 110F opposite the near side 110N, such that the bed 120 is adapted to move to and from the near side 110N and the far side 110F. Bed 120 may be configured to be positioned at the near side 110N when the crops are ready to be harvested. Similarly, the bed 120 may be configured to be

positioned at the far side 110F and/or between the near side 110N and the far side 110F when it is not ready to be harvested. After harvesting an earlier crop at the near side 110N, cups with seedlings (not shown in Fig. 1) may be placed in the beds 120 at the near side 110N. Beds 120 with the seedling may remain at the near side 110N and gradually move to the far side 110F and back to the near side 110N when ready to harvest. Alternatively, the beds 120 with the seedlings may be moved to the far side 110F at first and gradually move towards the near side 110N for harvesting. As shown in Fig. 1, the beds 120 in the plurality of frames 110 may be arranged in a staggered configuration, such that the beds 120 are able to receive direct sunlight. For example, as shown in Fig. 1, the bed 120A at the highest frame 110A is disposed at the near side 110N of the frame 110A and the bed 120B at the frame 110B may be disposed away from the position directly under the bed 120A. Bed 120C on the frame 110C may be disposed away from the position directly under the bed 120B and preferably away from the position directly under the bed 120A. As shown in Fig. 1, the beds 120 on the plurality of frames 110 arranged consecutively may form a step-like arrangement, e.g. the positions of beds 120A, 120B, 120C. When the distance between two frames 110 is more than a pre-determined magnitude, e.g. 2 metres, or when the number of frames between two frames 110 is more than a pre-determined number of frames 110, e.g. two frames, a bed 120 on a lower frame 110 may be positioned directly below another bed 120 on an upper frame 110. For example, the bed 120D may be positioned directly under the position of the bed 120A as the distance between the upper frame 110A and the lower frame 110D holding the bed 120D is more than 2 frames away. In this way, the arrangement allows sunlight to reach the bed 120D. Essentially, the beds 120 are not positioned directly above each other. In this way, the crops on the beds 120 are able to receive direct sunlight from above the hydroponic system 100. Plurality of frames 110 may be sectioned into an upper section of frames, e.g. frames 110A, 110B, and a lower section of frames below the upper section, e.g. frames 110E, 110F. Frames 110C, 110D may be an intermediate section of frames between the upper section and the lower section. Crops that are more matured are held by beds 120 in the upper section of the plurality of frames 110. As the matured crops have larger leaves, it is beneficial to expose them to more sunlight. Younger crops may be held by beds 120 in the lower section of the plurality of frames 110. Each of the plurality of frames 110 may be adjusted upwardly or downwardly in the vertical direction 100V to accommodate the height of the crops. Pre-determined spacing 110S between two frames 110 may be about 1m. However, the pre-determined spacing 110S between any two of the plurality of frames 110 may be adjustable by adjusting at least one of the two frames 110 upwardly

and/or downwardly. With adjustable spacings, the hydroponic system 100 may be tailored to suit different crops of different heights.

[0030] Hydroponic system 100 may include a pump 12P disposed in the aquaculture system 12 for pumping water, which comprises nutrients, in the aquaculture system 12 to the hydroponic system 100. Hydroponic system 100 may include a supply conduit 12S connected between the pump 12P and the beds 120 to channel the water from the aquaculture system 12 to the beds 120. Hydroponic system 100 may include a plurality of supply valves (not shown in Fig. 1) disposed at the proximal end 120P of the beds 120, each connecting a bed 120 to the supply conduit 12S, each of the plurality of supply valves is adapted to control the supply of water into the bed 120. Hydroponic system 100 may include a drainage conduit 12D connected to the bed 120 and aquaculture system 12 for draining the water from the bed 120 into the aquaculture system 12. Hydroponic system 100 may include a water duct (not shown in Fig. 1) disposed at the distal end 120D of the bed 120 and connected to the drainage conduit 12D. Water duct may be adapted to collect water from the bed 120 and channel it into the drainage conduit 12D. By disposing the hydroponic system 100 above the aquaculture system 12, the water may flow from the beds 120 to the aquaculture system 12 under the influence of gravity. Without using any additional pump to drain the water from the bed 120 to the aquaculture, less energy is used to run the aquaponic system 10. In addition, in the long run, running costs and maintenance costs are saved.

[0031] As shown in Fig. 1, the hydroponic system 100 may include one or more germination decks 102 adapted to hold seeds for germination. Germination deck 102 may include a plurality of trays 102T for holding the seeds. Each of the plurality of trays 102T may include a light permeable cover 102C and a light source 140 attached to the underside of the cover 124 adapted to emit light onto the tray 120T. Plurality of trays 102T may be in fluid communication with the supply conduit 12S to receive water and the drainage conduit 12D for draining water. Each of the plurality of trays 102T may hold a number of seeds. Germination deck 102 may be located below the plurality of frames 110. Germination deck 102 may allow sunlight to pass through. When the seeds have sprouted into seedlings, the seeds may be transferred into a plurality of perforated cups, each for holding a seed. the seedlings. Plurality of cups may be transferred to the plurality of frames 110 at the lower section of the plurality of frames 110. User may transfer the plurality of perforated cups (not shown in Fig. 1) onto the platform 130

when the platform 130 stops at the germination deck 102 and transfers the perforated cups to the beds 120 when the platform 130 stops at one of the plurality of frames 110.

[0032] Each of the plurality of frames 110 may include an actuating system (not shown in Fig. 1) adapted to actuate the movement of the bed 120 along the width of the frame 110. Actuating system may include a motor and a conveying system connected to the motor and the bed 120. Motor may be mounted on the frame or bed 120. Conveying system may convey the bed 120 along the width of the frame 120 when the motor is activated. Conveying system may include a gear and chain system, a gear and rack system, etc. Each of the plurality of frames 110 may have a width in the range of 3m to 6m. Each of the plurality of frames 110 may have a width in the range of 3m to 9m.

[0033] Fig. 2 shows a perspective view of an exemplary embodiment of the bed 120. Bed 120 may include a proximal end 120P fluidly connected to the supply conduit 12S and a distal end 120D, opposite the proximal end 120P, fluidly connected to the drainage conduit 12D. Bed 120 may include a plurality of elongated holders 122 adapted to hold the crops (not shown in Fig. 2), such that the plurality of elongated holders 122 extend in the longitudinal direction 100G and may be spaced apart from each other. Bed 120 may have a width that is within an arm's length of a person. For example, the bed 120 may have a width in the range of 0.6m to 1m. Preferably, the bed 120 may have a width in the range of 0.6m to 0.9m. In this way, the user on the platform 130 is able to harvest the crops at the side of the bed 120 furthest from the platform 130 when the bed 120 is at the near side 110N of the frame. Bed 120 may be up to 20m, 25m, 30m long. Each of the plurality of elongated holders 122 may include a tube comprising a plurality of openings 122P arranged along a top portion of the tube. Tube may be 0.1m, 0.15m in diameter. Each of the plurality of openings 122P may be adapted to receive the perforated cup holding a crop therein. Plurality of elongated holders 122 may be adjusted sideways to move in the lateral direction 100T to vary the spacing between each other so that the spacing may be increased when more space is required by the crops. Plurality of elongated holders 122 at the upper section of the plurality of frames 110 may be spaced further apart from each other than the plurality of elongated holders 122 at the lower section of the plurality of frames 110 as the elongated holders 122 at the upper section may hold more matured and larger crops. Plurality of elongated holders 122 may be open channels.

[0034] Hydroponic system 100 may include a light-permeable cover 124 attached the bed 120, such that the cover 124 extends across the width of the bed 120 and extends along the length of the bed 120 to form an enclosure adapted to enclose the crops therein. Cover 124 may be arcuated. Cover 124 may be a net.

[0035] Hydroponic system 100 may include a plurality of sensors (not shown in Fig. 1) configured to sense the parameters of the hydroponic system 100. Hydroponic system 100 may include light sensors configured to sense the amount light received by the crops. Light sensors may be installed between the plurality of frames 110. Preferably, the light sensors may be installed on the bed 120. Hydroponic system 100 may include flow sensors configured to sense the water flow through the bed 120. Flow sensors may be installed in the bed 120. Preferably, the flow sensors are installed in the elongated holders 122.

[0036] Hydroponic system 100 may include an air temperature control system (not shown in Fig. 1) configured to control the air temperature in the hydroponic system. Air temperature control system may include a plurality of temperature sensors (not shown in Fig. 1) disposed around and/or between the plurality of frames to detect the air temperature of hydroponic system and transmit an air temperature signal, a plurality of air blowers, e.g. fan, air pump, configured to create an airflow in the hydroponic system 100, and a mist emitting system (not shown in Fig. 1) configured to emit mist into the hydroponic system 100 to enable evaporative cooling in the hydroponic system 100. Mist emitting system may include a water tank, a plurality of nozzles fluidly connected to the water tank and disposed throughout the hydroponic system to emit mist and a pump for pumping the water to the plurality of nozzles.

[0037] Platform 130 may include a suspension lift actuated by a motor disposed at the top of the support structure 104. Suspension lift may support a weight up to 500kg. Preferably, the suspension lift may support a weight up to 2000kg. Platform 130 may be configured to elevate the user to the plurality of frames 110 and the germination deck 102 to attend to the crops, e.g. transfer the crops between the frames and deck, harvest the crops. Platform 130 may include safety arresters for preventing breakdown and sudden descend of the platform 130. Platform 130 may be attached to a side of the support structure 104. Platform 130 allows the user to move on it freely and more than one user is allowed on the platform 130. Platform 130 may

have a width of 1m, 2m, etc. Platform 130 may extend up to the length of the plurality of frames 110.

[0038] Hydroponic system 100 may include a light source 140 disposed underneath the cover 124 and adapted to emit light onto the crops held by a bed 120 thereunder. Light source 140 may be LED light tubes extending in the longitudinal direction 100G. Light source 140 may be light bulbs arranged along the longitudinal direction 100G and spaced apart from each other. When there is insufficient sunlight, the light source 140 may be turned on to emit light onto the crops.

[0039] Fig. 3 shows a side view of the embodiment of the hydroponic system 100 in Fig. 1. As shown in Fig. 3, the support structure 104 may be a frame that allows light to pass through to reach the beds 120. Plurality of frames 110 may be movably connected to the support structure 104. Bed 120 may be inclined such that the proximal end 120P of the bed 120 may be higher than the distal end 120D of the bed 120 to allow water to flow from the proximal end 120P to the distal end 120D. Pump 12P may be activated to pump the water from the aquaculture system 12 into the beds 120 via the supply conduit 12S at the proximal end 120P of the beds 120. As the water flow through the beds 120 from the proximal end 120P to the distal end 120D, the nutrients are absorbed by the crops. Water may exit the bed 120 and flows back into the aquaculture system 12 via the drainage conduit 12D at the distal end 120D of the beds 120. Plurality of frames 110 may have a length which extends to the length of the support structure 104. Bed 120 may have a length that extends to the length of the frame. Light source 140 may be disposed under each of the plurality of frames 110 to emit light onto the crops when need be.

[0040] Fig. 3A shows an exemplary embodiment of the aquaculture system 12. Aquaculture system 12 may be configured to manage the water for the hydroponic system 100. Aquaculture system 12 may be fluidly connected to hydroponic system 100. Aquaculture system 12 may include a nitrification tank 162 configured to nitrify the water, a holding tank 164 configured to hold the water and an aquaculture tank 166 for holding aquatic animals, both fluidly connected to the nitrification tank 162. Nitrification tank 162 and the holding tank 164 and the aquaculture tank 166 may be of the same length.

[0041] Nitrification tank 162 may be fluidly connected to the hydroponic system 100. Nitrification tank 162 may be fluidly connected to the drainage conduit 12D and adapted to receive and hold water from the hydroponic system 100 therein. Nitrification tank 162 may include a pump 162P configured to pump water therefrom into the holding tank 164. Nitrification tank 162 may include a water level sensor (not shown in Fig. 1) configured to detect the level of water therein and transmit a water level signal.

[0042] Aquaculture system 12 may include a plurality of parameter sensors 160S disposed in the nitrification tank 162, the plurality of parameter sensors 160S configured to detect the level of at least one of the following parameters in the water: Dissolved Oxygen (DO), Power of Hydrogen (PH), Electric Current (EC), and Oxidation Reduction Potential (ORP). Plurality of parameter sensors 160S may be configured to transmit a parameter level signal upon detection of the parameters.

[0043] Aquaculture system 12 may include a dosing system 170 configured to dose nutrients into the water in the nitrification tank 162. Dosing system 170 may include a plurality of dosing tanks, each containing a nutrient and a plurality of dosing pumps configured to pump the nutrient from the plurality of dosing tanks into the nitrification tank 162.

[0044] Holding tank 164 may be fluidly connected to the hydroponic system 100. Holding tank 164 may be adapted to receive water from the nitrification tank 162 and transfer the water therein into the hydroponic system 100. Holding tank 164 may include the pump 12P therein to pump the water therefrom into the supply conduit 12S of the hydroponic system 100.

[0045] Aquaculture system 12 may include a temperature control system 160 configured to control the temperature of the water. Temperature control system 160 may include a heat sensor 160H disposed in the holding tank 164 and configured to sense the temperature of the water therein and transmit a temperature signal and a heating element 160E disposed in the holding tank 164 and configured to heat the water therein.

[0046] Aquaculture system 12 may include an oxygen supply system 180 configured to supply oxygen into the water in the holding tank 164.

[0047] Aquaculture tank 166 may include a pump 166P configured to pump water therein into the nitrification tank 162. Water may be pumped from the aquaculture tank 166 into the nitrification tank 162 when the water level therein drops to a threshold level.

[0048] Nitrification tank 162 and the holding tank 164 may be a single nitrification tank. Accordingly, the heat sensor 160H and the heating element 160E may be disposed in the single nitrification tank and the oxygen supply system 180 may supply oxygen into the single nitrification tank. Aquaculture system 12 may automatically maintain the water at the optimal parameters and temperature for the crops.

[0049] Fig. 4 shows an exemplary embodiment of a controller system 150 configured to control the operation of the aquaponic system 10. Controller system 150 may be configured to control the hydroponic system 100 and/or the aquaculture system 12. Controller system 150 may include a server 150S. Server 150S may include a processor 150P and a memory 150M in communication with the processor 150P for storing instructions executable by the processor 150P. Controller system 150 may include at least one of a multimedia module 150U configured to display a user interface and receive user input, an audio module 150A configured to input/output audio signals, an input/output (I/O) interface 150N configured to provide an interface between the processor 150P and peripheral interface modules, e.g. keyboard, and a communication module 150C configured to facilitate communication between the controller system 150 and other devices or server. Controller System 150 may include a storage module 150D, e.g. a storage media, cloud server, configured to store program modules and data. Controller system 150 may be connected to at least one of the motors, the plurality of sensors, the plurality of supply valves, air temperature control system 160, the plurality of air blowers, the mist emitting system, the flow sensors, etc. Controller system 150 may be connected to at least one of the plurality of sensors 160S, the dosing system 170 170, the oxygen supply system 180, the temperature control system 160, the pump 162P, the pump 166P and the pump 12P. Controller system 150 may include an operation module 150T configured to operate the hydroponic system 100. Operation module 150T may be configured to operate the aquaculture

system 12. Operation module 150T may be stored in the memory 150M. Crop data, e.g. growth data, crop type, may be stored in the storage module 150D. Controller system 150 may be configured to communicate with a user mobile device or computer via the internet to allow the user to operate the aquaponic system 10 via the controller system 150.

[0050] Processor 150P may be configured to control the pump 12P to pump the water from the aquaculture system 12 to the hydroponic system 100. Processor 150P may be configured to receive a flow signal from the flow sensor . Processor 150P may be configured to control the operation of the plurality of supply valves and the pump 12P to control the flow rate of the water in the beds 120. Depending on the types of crops, the flow rate of the water in the beds of the crops may be controlled accordingly. Processor 150P may be configured to receive light signals from the light sensors and control the motors to move the beds 120 to the determined positions on the plurality of frames 110 to receive direct sunlight. Processor 150P may be configured to move the beds 120 to a configuration to receive optimal direct sunlight based on the light signals. Processor 150P may receive the air temperature signal from the plurality of temperature sensors. If the air temperature is above a first temperature threshold, the processor 150P may activate the plurality of air blowers to cool the hydroponic system 100. If the air temperature is above a second temperature threshold, the processor 150P may activate the mist emitting system to emit mist to further cool the air temperature evaporatively.

[0051] Fig. 5 shows a flow diagram of an exemplary method 1000 of arranging beds 120 of a plurality of frames 110. Processor 150P may execute the operation module 150T to operate the hydroponic system 100. Method 1000 includes identifying that the crops on a bed 120 of a frame 110 of the plurality of frames 110 is ready to be harvested based on crop data in block 1100 and moving the identified bed 120 to adjacent the platform 130 in block 1200. Processor 150P may receive crop data of the crops that are grown on the hydroponic system 100 and determine the growth of the crops based on the crop data. Based on the crop data, the processor 150P may identify the crops that are ready to be harvested. If so, the processor 150P is configured to move the identified bed 120 of the crop to be harvested to the near side 110N of the frame 110 adjacent the platform 130 for the crops to be harvested. Processor 150P may control the motor of one or more of the plurality of frames 110 at the upper section to be position at the near side 110N of the frame 110 for the user to harvest the crops. Method 1000

further includes staggering the beds 120 of a remaining plurality of frames 110 below the frame 110 to receive optimal direct sunlight in block 1300. Based on the operation module 150T, the processor 150P may stagger the beds 120 below the frame 110 to receive optimal direct sunlight. If the processor 150P receives a light signal from a light signal at a bed 120 to be below a light threshold and is not possible to move the bed 120 to a suitable position, the processor 150P may activate the light source 140 to emit light on to the crops. Processor 150P may activate the pump 12P to deliver more water from the aquaculture system 12 to the beds 120 if the processor 150P receives a flowrate signal indicating that the flow rate of one or more beds 120 are below a threshold flowrate. Processor 150P may shut the supply valves of the beds 120 that have a flow rate above the threshold flowrate and open the supply valves of the beds 120 that have a flow rate below the threshold flowrate.

[0052] Processor 150P may be configured to control the operation of the aquaculture system 12. Processor 150P may be configured to receive a water level signal from the water level sensor and determine if the water level in the nitrification tank 162 is above the threshold level. If it is below the threshold level, the processor 150P may activate the pump 166P to pump water from the aquaculture tank 166 into the nitrification tank 162. Processor 150P may be configured to receive the parameter level signal from the plurality of parameter sensors 160S and determine the parameter levels of the water in the nitrification tank 162. If the parameters are below a parameter threshold level, the processor 150P may activate the dosing system 170 to dose the water in the nitrification tank 162. For example, if the PH and EC values of the water is below the parameter threshold level, the relevant nutrients may be dosed into the water. Processor 150P may activate the pump 162P to pump water from the nitrification tank 162 into the holding tank 164. If the DO value in the water is below the parameter threshold value, the processor 150P may activate the oxygen supply system 180 to supply oxygen into the holding tank 164. Processor 150P may be configured to receive the temperature signal from the heat sensor 160H. If the temperature of the water in the holding tank 164 is below a temperature threshold, the processor 150P may activate the heating element 160E to heat the water to the threshold temperature. When the water is in the pre-determined condition, i.e. within threshold parameters and temperature. Processor 150P may activate the pump 12P to pump the water into the hydroponic system 100.

[0053] Hydroponic system 100 may include at least one of Deep Water Culture (DWC) system and Nutrient Film Technology (NFT) system.

[0054] Aquaponic system 10 is designed to adapt to the natural environment which benefits both the aquatic animals and crops. Aquaponic system 10 utilizes the natural rainwater for the aquatic animals where the waste produced are converted into nutrients for the growth of the crops. As compared to other systems, the aquaponic system 10 is designed to expose the crops to as much sunlight as possible to enable the optimal growth of the crops. For example, the aquaponic system 10 is designed in such a way that sunlight only falls on crops in the vegetative state. Results have shown that seedlings do not require much sunlight for growth while crops in the vegetative stage thrive rapidly under the sunlight. Hence, more space is created to allow as much sunlight as possible to the crops in the vegetative stage, thus allowing harvest of a larger batch of crops.

[0055] Aquaponic system 10 enables fast and efficient access to the crops and hence reduces the cost of access. User is able to transfer the crops between the germination decks 102 and the plurality of frames 110 and between the plurality of frames 110 easily and quickly. Compared to traditional land-based farming, the aquaponic system 10 is able to intensify the land use and produce at least 28 times more of produce, e.g. fish and vegetable. Aquaponic system 10 provides a controlled environment which enables stringent control of input materials to the crops and aquaculture. In this way, the aquaponic system 10 provides food supply safety, security and assurance. Aquaponic system 10 also provide an ecosystems environment with zero waste discharge with balance carbon.

[0056] A skilled person would appreciate that the features described in one example may not be restricted to that example and may be combined with any one of the other examples.

[0057] The present invention relates to an aquaponic system generally as herein described, with reference to and/or illustrated in the accompanying drawings.

Claim

1. An aquaponic system comprising:
 - a hydroponic system disposed above and in fluid communication with an aquaculture system, the hydroponic system comprising,
 - a plurality of frames arranged in a vertical direction and spaced apart from each other at a pre-determined spacing, wherein the plurality of frames are adapted to allow light therethrough, wherein each of the plurality of frames comprises a length extending in a longitudinal direction perpendicular to the vertical direction and a width extending in a lateral direction perpendicular to the vertical direction and the longitudinal direction, wherein each of the plurality of frames comprises a bed having a length extending in the longitudinal direction and slidably attached to the each of the plurality of frames and adapted to slide along the width of the each of the plurality of frames, wherein the bed is adapted to hold crops and fluidly connected to the aquaculture system, and
 - a platform for supporting a user and adapted to travel to the plurality of frames in the vertical direction.
2. The aquaponic system according to claim 1, wherein the bed comprises a plurality of elongated holders adapted to hold crops, wherein the plurality of elongated holders extend in the longitudinal direction and are spaced apart from each other.
3. The aquaponic system according to claim 2, wherein the plurality of frames are sectioned into an upper section of frames and a lower section of frames below the upper section, wherein the plurality of elongated holders at the upper section are spaced further apart from each other than the plurality of elongated holders at the lower section.
4. The aquaponic system according to claim 2 or 3, wherein each of the plurality of elongated holders comprises a tube comprising a plurality of openings arranged along the tube.
5. The aquaponic system according to any one of claims 1 to 4, wherein the beds in the plurality of frames are arranged in a staggered configuration, wherein the beds are able to receive direct sunlight.

6. The aquaponic system according to any one of claims 1 to 5, wherein each of the plurality of frames has a near side adjacent the platform and a far side opposite the near side, wherein the bed is adapted to move to and fro the near side and the far side, wherein the bed is configured to be positioned at the near side when the crops are ready to be harvested.
7. The aquaponic system according to any one of claims 1 to 6, wherein the bed comprises a width in the range of 0.6m to 1m.
8. The aquaponic system according to any one of claims 1 to 7, further comprising a light-permeable cover attached the bed, wherein the cover extends across the width of the bed and along the length of the bed to form an enclosure adapted to enclose the crops therein.
9. The aquaponic system according to claim 8, further comprising a light source disposed under one or more of the plurality of frames and adapted to emit light onto the crops held by a bed thereunder.
10. The aquaponic system according to any one of claims 1 to 9, wherein the pre-determined spacing between any two of the plurality of frames is adjustable.
11. The aquaponic system according to any one of claims 1 to 10, wherein the platform extends up to the length of the plurality of frames.
12. An aquaponic system comprising:
 - a hydroponic system disposed above and in fluid communication with an aquaculture system, the hydroponic system comprising,
 - a plurality of frames arranged in a vertical direction and spaced apart from each other at a pre-determined spacing, wherein the plurality of frames are adapted to allow light therethrough, wherein each of the plurality of frames comprises a length extending in a longitudinal direction perpendicular to the vertical direction and a width extending in a lateral direction perpendicular to the vertical direction and the longitudinal direction, wherein each of the plurality of frames comprises a bed having a length extending in the longitudinal

direction and slidably attached to the each of the plurality of frames and adapted to slide along the width of the each of the plurality of frames, wherein the bed is adapted to hold crops and fluidly connected to the aquaculture system,

a platform for supporting a user and adapted to travel to the plurality of frames in the vertical direction,

a processor,

a memory in communication with the processor for storing instruction executable by the processor, the processor configured to:

identify that the crops on a bed of a frame of the plurality of frames is ready to be harvested based on crop data,

move the identified bed to adjacent the platform for the crops to be harvested, and

stagger the beds of a remaining plurality of frames below the frame to receive optimal direct sunlight.

13. A method of arranging beds of a plurality of frames of an aquaponic system according to claim 12, the method comprising:

identifying that the crops on a bed of a frame of the plurality of frames is ready to be harvested based on crop data,

moving the identified bed to adjacent the platform for the crops to be harvested, and

staggering the beds of a remaining plurality of frames below the frame to receive optimal direct sunlight.