TITLE OF INVENTION

VERTICAL FARMING SYSTEM FOR HYDROPONICS GROWTH

BACKGROUND OF THE INVENTION

A. Field of The Invention

The present invention relates to farming tower structure, and in particular, an off grid vertical growing tower system suitable for use in outdoor farming, wherein the system is able to install a plurality of solar panels with rain water collection, and electricity generated from these solar panels provides the necessary power for the operation of water pumping for use in the vertical farming of crops within the tower system and for use in supporting other necessary farm operations such as supporting lightings of the tower, etc.

B. Description of Prior Art

At present, there is a need for large scale production of food to supply emerging food markets and to offset impacts to food supplies and land usage. The increasing global population is placing pressure on food, land and other resources. Many proposed systems and methods had addressed portions of the needs for automated or high-density production of crops for food but had not addressed the optimal characteristics as proposed here.

Many available documents failed to address a vertical arrangement for growing crops, allowing seedling, immature, and mature plants to occupy portions of the growing apparatus at the same time and to arrange them in such a way as to optimize space resource utilization.

US Patent No. 4,216,617 does not disclose a truly continuous loop in that an operator would periodically have to replace top and bottom portions of the vertical apparatus and also failed thereby to produce a continuous automatable system. In addition, there is no disclosure or teaching on off-grid vertical tower where rain water is collected and is being used to supply to the growing crops in the tower.

In order to substantially increase the production of food, there is a need to fully utilize limited space and resource for farming as well as to produce crops on optimized vertical structure. In addition to increasing the speed of production, increasing the speed of harvest, and reducing labour and materials costs, automation will allow the growth of plants in conditions which are optimal for plants. So, there is a need to configure farming facilities which can take advantage of the highest crop density afforded by a vertical arrangement.

A novel design is needed for a towered or vertical framework which allows enough free space and porosity for natural sunlight to filter through and scatter on wall-to-wall of the towered structure. In addition, the design is based on the absolute minimization of construction materials. The design and structure disclosed in US Patent No. 6,508,033 were material intensive and the fabrication of the same is laborious and not cost effective.

US Patent No. 6247268B1 discloses an improved adjustable hydroponic device wherein said device comprises a container defining a substantially tubular shaped reservoir including at least one plant site opening, an adjustable substantially disk shaped baffle defining a bulkhead including at least one liquid passage opening, and at least one plant support device, said baffle being sealingly and adjustably mounted within said reservoir, said at least one plant support device being mounted within said at least one plant site opening, and wherein adjustment of said baffle causes an adjustment to at least one of the following group of items consisting of containable liquid level within said reservoir and flow rate of liquid from within said reservoir.

Current urban farming technology in Singapore is of two types, namely outdoor technology and indoor technology. Outdoor technology for urban farming needs to use horizontal pipe structure as a growing system. The pipe structure allows for better growth compared to traditional soil farming. Such pipe structure employed hydroponics system is used to grow crops and the growing medium used is leica beads. The shortcoming of the outdoor technology is that leverage of piping is needed in this outdoor technology and nutrient film technology is also employed in the outdoor technology farming.

The indoor farming practises leverage on growing rack system. This technology allows indoor farmers to leverage on height to grow more plants per square foot. This farming practise is a faster method compared to traditional farming as indoor farms leverage on LED lights and heating, ventilation, and air conditioning (HVAC) regulated systems to grow crops. With a regulated system, temperature and humidity of the crops can be controlled. This would allow plants to grow more systematically and without any reliance on sunlight. The shortcoming of the indoor farm is the cost of the LED lights. With approximately 40% of the running cost attributed to LED lights. Theses indoor farms lack the scalability of the farm. Due to the fact that most of the indoor farms available are only growing high value crops such as kale, it is almost not possible to grow common leafy vegetables and still turn a profit. Accordingly, the proposed invention not only solves the drawbacks backs mentioned above, but also can be used to plant crops of high value and in a larger scale.

SUMMARY OF THE INVENTION

The invention relates to vertical farming system, wherein leverage on horizontal pipe growing structure is not applicable, but the present farming system provides 4 to 8 times more crops than conventional type of vertical farming system. No leica beads are used but growing medium is used in the present system. The crops are grown on sponges attached to the growth area on the hexagon of the farming system, and a water delivery system is used in the farming system which is a plurality of sprinklers to supply water to each of the growth crops on the sponges.

A main object of the present invention is to provide a vertical farming system, which allows for environmentally sustainable agriculture, and allow the user of the farming system to help ameliorate and reduce carbon emissions by using renewable resource-use hydroponics system in growing of crop.

Another object of the present invention is to provide a vertical farming system directed to facilitating users of the assembly to grow crops through the use of solar, rain water which provides carbon offsetting abilities so as to reduce carbon emissions.

An aspect of the present invention is to provide an off grid vertical farming system, wherein the roots of the crops are angled such that water comes in contact with the roots and encourages root growth due to the gravitational angled designed in the vertical farming system. The present invention makes use of vertical tower with ultra-high volume for commercial growing of crops, an approximate of 2000 plants is being grown on a space of 2 m by 2 m. The height of the vertical tower of the present invention can be adjusted and therefore the number of plants grown can be increased.

Another aspect of the present invention is to provide an off grid vertical farming system, wherein the pump for delivery water to supply to the plants is operated by using power generated by the solar panels installed on the vertical farming tower structure.

A main object of the present invention is to provide an off grid vertical farming system (100) comprising:

(i) a skeletal frame (50) being formed from a plurality of vertical supporting frame (10) and a plurality of horizontal supporting frame (10'), defining at least six vertical planes or hexagon (12) as plants/crops growth area (14), and being configured to support the vertical planes or hexagon (12), wherein the growth area (14) is area where crops are growth of the farming system (100);

(ii) a roof hexagon (20) which is formed by the plurality of horizontal supporting frame (10') at the upper part of the skeletal frame (50); and

(iii) a base hexagon (30) which is formed by the plurality of horizontal supporting frame (10') at the lower part of the skeletal frame (50); thereby the skeletal frame (50) forms into a vertical skeletal tower structure with hexagonal sides which allow for optimizes sun exposure for the crops grown on each of the hexagon growing area (14).

An object of the present invention is to provide a vertical farming system (100), further comprising a plurality of sprinklers (80) to spray water and liquid nutrients to each of the plant on the growth area (14) of the farming system (100).

Yet another object of the present invention is to provide a vertical farming system (100), further comprising a water funnel (90) mounted on the base hexagon (30) for collection of water and the water is channelled to a water storage (92) linked by the plurality of tubes connected to a pressurized tube (82) to supply water to the sprinklers (80).

Still a further object of the present invention is to provide a vertical farming system (100), wherein on the growth panel (70), a plurality of holes (72) are angled at 30 degree on the growth panel (70).

A further object of the present invention is to provide a vertical farming system (100), wherein the each of the hexagon (12) is mounted with the growing panel (70) with the plurality of holes (72) spanning across the entire length and width thereof.

Still yet another object of the present invention is to a vertical farming system (100), wherein the holes (72) are filled with plant growth medium for planting crops, and the pressurized tube (82) is linked to the sprinklers (80) which are mounted on the roof hexagon (20) to supply pressurized water to the plant/crop on the holes (72) of the growth panel.

Another further object of the present invention is to provide a vertical farming system (100), further comprising a water storage (92) which supplies water to the sprinklers (80) for the plants on the growth area and a plurality of supporting poles being mounted to the holes (72) such that water supplies to the plant on the hole is collected by the poles.

Further object of the present invention is to provide a vertical farming system, wherein a water deflector was integrated into the supporting poles so as to direct the water flowing down the poles to the funnel (90), and the water flowing down from the poles is collected at the center of the funnel (90).

Yet a further object of the present invention is to provide a vertical farming system, wherein the at least one sprinkler (80) is being mounted on the roof hexagon at each hexagon panel to provide water supply to the plant mounted on the growth area of the hexagon panel and the sprinkler is used for each side of the hexagon to ensure crop across the entire plant growth is watered sufficiently for growth of the crop.

Another further object of the present invention is to provide a vertical farming system, wherein the roof hexagon and the hexagon of the growth area are provided with an outer surface and an internal surface, and the top surface of the roof hexagon is mounted with a tarp or the like.

A further object of the present invention is to provide a vertical farming system, wherein the internal surface of the hexagon side is provided with a tarp or the like and the base hexagon (30) has a minimal floor area of 2-3 square meter.

Yet a further object of the present invention is to provide a vertical farming system, further comprising a sensor detection device for monitoring of nutrient levels in the water for sprinkles, to actuate any additional top up of water and nutrients, and a centralized watering system linked by a plurality of tubes to supply water to the sprinklers, allowing water to be sprayed to the roots of the crops or plants in the growing area of the tower, wherein the centralized watering system contains plant nutrients and a sensing detection device is being used to monitor nutrient levels of the watering system to actuate the supply of water and nutrients needed to the crop/plant.

Another object of the present invention is to provide a vertical farming system, wherein the solar panel and a water collector are able to provide power for the circulation of water supplying to the plants growth on the growth area of the tower, and the water collected by the water collector is transported to the water storage.

These and other features, aspects and advantages of the present invention will become better understood with reference to the following drawings, description and claims.

BRIEF DESCRIPTION OF THE DRAWINGS

A fuller understanding of the nature and objects of the present invention will become apparent upon consideration of the following detailed description, taken in connection with the accompanying drawings, wherein:

FIG. 1 is a perspective view of an off-grid vertical farming tower structure in accordance with the present invention, wherein the tower structure is hexagonal;

FIG. 2 is a perspective view of an off-grid vertical farming tower structure in accordance with the present invention, wherein a plurality of panels are mounted to the tower structure;

FIG. 3 is a perspective view of an off-grid vertical farming tower structure, wherein the tower is provided with a plurality of sprinkles, the funnel and the water deflector are shown on the tower structure, in accordance with the present invention.

FIG. 4 is a top view of a water funnel (90) of the off-rid vertical farming tower structure in accordance with the present invention;

FIG. 5 is a sectional view of the water funnel (90) along line A-A of FIG. 4 in accordance with the present invention.

FIG. 6 is a schematic view of detachable vertical growth panel (70) in accordance with the present invention.

DETAILED DESCRIPTION OF THE INVENTION

The following detailed description is of the best currently contemplated modes of carrying out exemplary embodiments of the invention. The description is not to be taken in a limiting sense, but is made merely for the purpose of illustrating the general principles of the invention, since the scope of the invention is best defined by the appended claims.

Referring to FIG. 1, broadly, an embodiment of the present invention provides an off-grid vertical farming system (100), which comprises (i) a skeletal structure (50), (ii) a roof hexagon (20), and (iii) a base hexagon (30). In accordance with the preferred embodiment of the present invention, the skeletal structure (50) is being formed from a plurality of vertical supporting frame (10) and a plurality of horizontal supporting frame (10'), defining at least six vertical planes or hexagon (12) for the mounting of a vertical growth panel (70) to each of the hexagon (12), and is being configured to support the vertical growth panel (70), wherein the plant vertical growth panel (70) is an area where crops are growth in the farming system (100). The roof hexagon (20) which is formed by the plurality of horizontal supporting frame (10') is mounted on the top portion of the skeletal structure (50), and the base hexagon (30) which is formed by the plurality of horizontal supporting frame (10') mounted at the lower portion of the skeletal structure (50). At least a tube (not shown) is linked to the skeletal structure (50), and is configured to supply water and nutrients to plants or crops on the growth panel (70). The skeletal structure (50) forms into a skeletal tower having hexagonal sides which allow for optimizes sun exposure for the plants on each of the growth panel (70).

As shown in FIG. 1, there is shown a perspective view of the skeletal structure (50) of the preferred embodiment of the present invention. In accordance with the present invention, the skeletal structure (50) provides the supporting frame (10) of the vertical growing system (100). The height of the skeletal structure (50), for example, is in between 2-3 metre, and has a minimal floor area of 2 square meter. The dimension of the skeletal structure (50) depends greatly on the space available for the vertical farming. The skeletal structure (50) is formed into hexagonal shape, which allows optimized sun exposure for the crops or plants on each side of the hexagonal. In general, the skeletal structure (50) of the vertical farming tower system (100) has three main portions, namely, the roof hexagon (20), the base hexagon (30) and a plurality of supporting frame (40), wherein the supporting frame (40) includes the vertical frame (10) and the horizontal frame (10').

A plurality of struts (51) are incorporated between the horizontal frame (10') of the base hexagon (30) to provide enhanced stability for the tower structure (100). In the preferred embodiment, all the parts of the skeletal structure (50) are fabricated from galvanized steel for corrosion resistance. The skeletal structure (50) or the vertical supporting frame (10) or the horizontal supporting frame (10') has a diameter of about 22-25 mm so as to provide sufficient material strength and stiffness throughout the farming of crops.

As shown in the figure, the roof hexagon (20) is the top portion of the skeletal structure (50) of the vertical farming system (100), wherein the edges of roof hexagon (20) are formed from horizontal supporting frame (10') and in between the horizontal supporting frames (10'), more than one struts (51) are used to enhance the roof hexagon (20). Similarly, the edges of the base hexagon (30) are formed by a plurality of horizontal supporting poles (10') and in between the horizontal supporting frame (10'), there are struts (51) to enhance the stability of the skeletal structure (50).

In accordance with the preferred embodiment of the present invention, the skeletal structure (50) includes the vertical supporting frame (10) and the horizontal supporting frame (10'). The skeletal frame (50) is formed into hexagon sides (12), the roof hexagon (20) and the base hexagon (30). The struts (51) are used to be incorporated between the horizontal supporting frame (10') of the base hexagon (30) and the roof hexagon (20) so as to provide enhanced stability of the towering structure. The vertical supporting frame (10), the horizon supporting frame (10'), the struts (51) for the roof hexagon (20) and the base hexagon (30) of the present invention are made from material such as galvanized steel for corrosion resistance, and the diameter of the frame is in the range of 20-30 mm. In general, material which can provide sufficient strength and stiffness is used for fabrication of the skeletal structure of the towering system (100).

In accordance with the present invention, the skeletal structure (50) is provided with 6 sided (hexagon), however, more than 6 sided is possible, and each side of the hexagon is used to house a growing panel (70).

FIG. 2 is a perspective view of an off-grid vertical farming tower structure in accordance with the present invention, wherein a plurality of panels (70) are mounted onto the tower structure. As shown, each side of the hexagon (12) of the vertical farming tower system (100) is provided with a growing panel (70). In a preferred embodiment, the height of the growing panel (70) is about 2 m. These panels (70) are provided with a plurality of through holes (72) equally spaced out on the panel (70), and the through holes (72) are arranged across the entire length and width thereof. As shown in FIG. 6, these growing panels (70) are detachable from the tower structure so that the panels (70) can be placed on the floor in the course of seedling planting and/or harvesting the crops growing on the panels (70). These growing panels (70) can be detachably and pivotedly mounted. The growing panel (70) is provided with a pair of pivots (93', 93) mounted at one edge of the growing panel (70) and is pivotally mounted onto the vertical supporting frame (10). Another edge of the growing panel (70) opposite to the edge that provided with the pivots (93', 93), a locking member (91) is mounted such that the growing panel (70) can be secured to the supporting frame (10) in the course of planting of crops. The number of holes (72) arranged on the growing panel (70) is determined by the minimum spacing specified between adjacent vertical and horizontal holes (72). The minimum spacing may be related to the kind of crops to be planted. In addition, in order to facilitate the continuous flow of water, the holes (72) are made to be angled at 30 degree without compromising on the support that plants need during each harvesting cycle. The same material used for the growing panel (70) will be utilized as a form of roofing for the growing structure. To ensure that the interior of the structure is sheltered from rain, a piece of tarp or the like (not shown) is used to mount on to the top of the roofing and be secured at each hexagon side (12). A plurality of solar panels can be installed to the roof hexagon (20) of the skeletal structure so as to provide electrical power to the farming system.

The supporting frame (10) can be provided with a plurality of LEDs to provide light to the entire tower system. The lighting will expedite the growth of the crops at night and for lighting purposes.

As shown in FIG. 3, there is shown a perspective view of the skeletal structure (51) with a plurality of water sprinklers (80), a funnel (90) with a water deflector (not shown) in accordance with the present invention. In the preferred embodiment, the sprinklers (80) are mounted to a pressurized tube (82) mounted onto the horizon supporting frame (10') of the roof hexagon (20). During each of the watering cycle, water is delivered to the interior of the vertical farming

tower system (100) via the sprinklers (80), and each of the sprinkler (80) is used for each side of the hexagon (12) to ensure that each crop across the entire growth panel (72) is watered sufficiently for growth. As the water trickles down the growing panels (72), the water funnel (90) which is attached to the base hexagon (30) will collect the water and channel the collected water back to a water storage source for reuse in the next watering cycle for the crops. Additionally, in order to ensure that most of the water is conserved, a plurality of water deflector are integrated into the supporting frame (40). The water flowing down the supporting frame (10) are then directed towards the centre of the funnel (90) for collection.

FIG. 4 is a top view of a water funnel (90) of the off-rid vertical farming tower structure in accordance with the present invention;

FIG. 5 is a sectional view of the water funnel (90) along line A-A of FIG. 4 in accordance with the present invention.

Since certain changes may be made in the foregoing disclosure without departing from the scope of the invention herein involved, it is intended that all matter contained in the above description and depicted in the accompanying drawings be construed in an illustrative and not limiting sense.

CLAIMS

1. An off grid vertical farming system (100) comprising:

(i) a skeletal structure (50) having a top portion and a bottom portion, being formed from a plurality of vertical supporting frame (10) and a plurality of horizontal supporting frame (10'), defining at least six vertical panels (12) as hexagon being plant vertical growing panels (70) for crops, the skeletal structure (50) configured to support the vertical growing panels (70) in a vertical position, wherein the plant vertical growth panel (70) is an area where crops are grown in the vertical farming system (100);

(ii) a roof hexagon (20) which is formed by a plurality of horizontal supporting frame (10') mounted on the top portion of the skeletal frame (50); and

(iii) a base hexagon (30) which is formed by a plurality of horizontal supporting frame (10') mounted on the bottom portion of the skeletal frame (50); thereby the skeletal frame (50) forms into a skeletal tower structure of hexagonal shape which allows for optimizes sun exposure for the crops planted on each of the vertical growing panel (70).

2. The off grid vertical farming system (100) of claim 1, further comprising a plurality of sprinklers (80) mounted onto a pressurized tube (82) for spraying water and liquid nutrients to each of the crops on the vertical growing panel (70) of the farming system (100), wherein the pressurized tube (82) is disposed onto the roof hexagon (20) and the sprinkles (80) are located at a position on the pressurized tube (82) where the spraying of water and liquid nutrients reaches the roots of the crops.

3. The off grid vertical farming system (100) of claim 1, further comprising a water funnel (90) mounted on the base hexagon (30) for collecting water from the sprinklers (80) and the water collected is pumped to a water storage which provides water and the liquid nutrients to the sprinklers (80).

4. The off grid vertical farming system (100) of claim 1, wherein each of the hexagon of the skeletal structure (50) is mounted with the vertical growth panel (70), wherein the vertical panel (70) is provided with a plurality of holes (72) for growing crops spanning across the entire length and width thereof.

5. The off grid vertical farming system (100) of claim 4, wherein the holes (72) are angled at 30 degree to the horizon.

6. The off grid vertical farming system (100) of claim 5, wherein the holes (72) are filled with plant growth medium for planting crops one on each hole (72).

7. The off grid vertical farming system (100) of claim 2, wherein the pressurized tube (82) is linked to each of the sprinklers (80) and the pressurized tube (82) is positioned onto the roof hexagon (20) to supply pressurized water to the crops on the holes (72) of the growth panel (70).

8. The off grid vertical farming system (100) of claim 1, wherein the water storage contains water and the liquid nutrients for crops.

9. The off grid vertical farming system (100) of claim 1, further comprising a plurality of supporting poles being mounted to the holes (72) such that water supplied to the plant on the holes (72) is collected by the poles.

10. The off grid vertical farming system (100) of claim 2, wherein each of the sprinklers (80) is used for each side of the vertical growth panel (70) to ensure all the crops on the growth panel (70) are been watered sufficiently for growth of the crop.

11. The off grid vertical farming system (100) of claim 1, wherein the roof hexagon (20) and the hexagon of the growth area are provided with an outer surface and an internal surface, and the top surface of the roof hexagon (20) is mounted with a tarp or the like.

12. The off grid vertical farming system (100) of claim 1, wherein the base hexagon (30) has a minimal floor area of 2-3 square meter.

13. The off grid vertical farming system (100) of claim 2, further comprising a centralized watering system linked by a plurality of tubes to supply water to the sprinklers (80).

14. The off grid vertical farming system (100) of claim 1, wherein a plurality of solar panels are installed to the roof hexagon (20) of the skeletal structure so as to provide electrical power to the skeletal structure (50).

15. The off grid vertical farming system (100) of claim 1, wherein the growing panels (70) are detachable from the tower structure so that the panels (70) can be placed on the floor in the course of seedling planting and/or harvesting the crops.

16. The off grid vertical farming system (100) of claim 3, wherein the water collected by the water funnel (90) is transported to the water storage (92).