ISSN2394-3777 (Print)
ISSN2394-3785 (Online)
Available online atwww.ijartet.com
International Journal of Advanced Research Trends in Engineering and Technology (IJARTET)
Vol. 5, Special Issue 12, April 2018

A NOVEL APPROACH ON REDUCING HEATING ISLAND EFFECT USING ROOF TOP AQUAPONIC SYSTEMS

Santhosh M(1), Kavyaa K(2), Jeeva M(3), Shanmuga priya K(4) Surekha M(5) UG Students[1, 2, 3,4], Assistant professor[5]

Department of Electrical and Electronics Engineering, Knowledge Institute of Technology, Salem.

Abstract— Now a day, people suffer mainly by the shortage of food in the world and the changing climatic conditions of the world. In order to overcome this problem, an emerging technology called Aquaponic is introduced. The aquaponic is a food production technology that combines the aquaculture and hydroponics to remain in a symbiotic relation. This forms a closed loop system by connecting the fish pond with the plant growing bed. The water from the fish growing pond is rich in nitrogen components which is the major requirement for the growth of plants. This involves the circulation of water along with the nutrients involved throughout the cycle and neglects all the contaminated residuals in it, in order to grow the terrestrial plants along with aquatic life. The water is fed from a well to the pond where it undergoes continuous estimation of the level of nitrates, nitrites and p^H levels in water. The plant growing beds can be set up at the roof tops and side walls of buildings. Hence this circulation of water helps for the cooling of building environment and also there will be great yielding through the grown fishes and vegetables.

Keywords: Aquaponics, Aquaculture, Circulation,Hydroponics, Residuals, Symbiotic relation.

I.INTRODUCTION

The agriculture is the only method for food production in olden days. But now, by the development of technology and consecutive researches in the field of agriculture, emerged a new technology called aquaponics. The aquaponic is a new farming method that involves the cultivation of crops in water which bears the excretory waste of aquatic species. The excretory waste of these animals is rich in nitrogen content that supplies the sufficient contents for the growth of the plants. The plants which are in need of these nutrients utilize them and filter the water which can be reused again and again for this process. Since it forms a closed loop system along with reuses, there is not any release of harmful substances into the environment. An **urban heat island** (**UHI**) is an urban area or metropolitan area that is significantly warmer than its surrounding rural areas due to human activities. Not all cities have a distinct urban heat island. Mitigation of the urban heat island effect can be accomplished through the use of green roofs and the use of lighter-colored surfaces in urban areas, which reflect more sunlight and absorb less heat. The plant growing beds(pipelines) are made to be aligned on the outer walls and roof tops of the building. Due to the continuous circulation of water, the temperature of the building remains cool.

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II.LITERATURE SURVEY

Navigating towards Decoupled Aquaponic Systems:

The classical working principle of aquaponics is to provide nutrient-rich aqua cultural water to a hydroponic plant culture unit, which in turn depurates the water that is returned to the aquaculture tanks. A known drawback is that a compromise away from optimal growing conditions for plants and fish must be achieved to produce both crops and fish in the same environmental conditions. The objective of this study was to develop a theoretical concept of a decoupled aquaponic system (DAPS), and predict water, nutrient (N and P), fish, sludge, and plant levels. This has been approached by developing a dynamic aquaponic system model, using inputs from data found in literature covering the fields of aquaculture, hydroponics, and sludge treatment. The outputs from the model showed the dependency of aqua cultural water quality on the hydroponic evapotranspiration rate. This result can be explained by the fact that DAPS is based on one-way flows. These one-way flows results in accumulations of demineralized nutrients in the hydroponic component ensuring optimal conditions for the plants. The study also suggests to size the cultivation area based on P availability in the hydroponic component as P is an exhaustible resource and has been identified one of the main limiting factors for plant growth.

Survey of Aquaponics in Europe

International aquaponic production has increased over the past decade, but less is known about research activities and production facilities operating in Europe. We conducted an online survey to get a better idea about research and production in Europe, focusing on five areas of aquaponics (i.e., demographics, facilities used, fish and crops produced, funding sources, and personal or company priorities for further development). The 68 respondents were distributed among 21 European countries, 43% were working at a university, and 19% were commercial producers. Only 11.8% of those surveyed had sold fish or plants in the past 12 months. Most respondents were male (66.2%) and had a post-graduate degree (91.7%). Facilities were generally new (74.5% constructed after 2010) and self-designed. Production figures were modest, with less than 10 respondents producing more than 1000 kg of fish or plants per year (mostly tilapia or catfish and herbs or lettuce). Systems were often funded by government grants (35.3%). The great majority of respondents (80.4%) stated that aquaponics was not their main source of income. Most respondents prioritized using aquaponics for educational purposes, while few (25%) used it to produce their own food or improve their health. Questions related to personal knowledge about aquaponics underlined the need for more training about fish diseases and plant pests.

Nutrients and Energy Balance Analysis for a Conceptual Model of a Three Loops off Grid, Aquaponics

Food security, specifically in water scarce regions, is an increasing local and global challenge. Finding new ways to increase agricultural production in a sustainable manner is required. The current study suggests a conceptual model to integrate established recirculating aquaculture practices into a near-zero discharge aquaponic system that efficiently utilizes water, excreted nutrients and organic matter for energy. The suggested model allows significantly extending the planted area and

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recovering energy in the form of biogas to operate the system off-grid. A mass balance model of nitrogen, carbon and energy was established and solved, based on data from the literature. Results demonstrate that a fish standing stock of about 700 kg would produce 3.4 tons of fish annually and enough nutrients to grow about 35 tons of tomatoes per year (chosen as a model plant) and recover sufficient energy (70 kWh/day) to run the system on biogas and use less water. If proven successful, this approach may play a major role in sustainably enhancing food security in rural and water scarce regions.

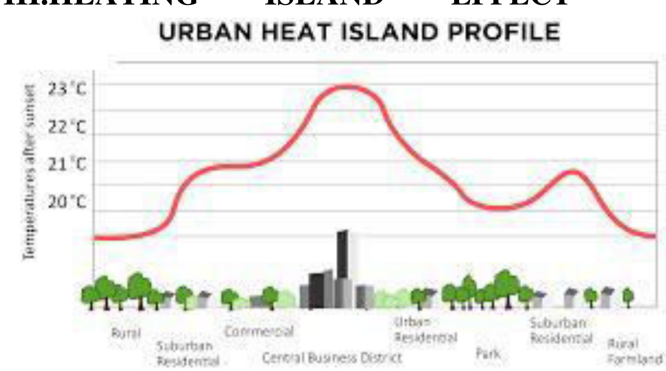
Strategic Points in Aquaponics

Global environmental, social and economic challenges drive the need for new and improved solutions for food production and consumption. Food production within a sustainability corridor requires innovations exceeding traditional paradigms, acknowledging the complexity arising from sustainability. However, there is a lack of knowledge about how to direct further activities, to develop technologies as potential solutions for questions related to climate change, loss of soil fertility and biodiversity, scarcity of resources, and shortage of drinking water. One approach that promises to address these problems is controlled environment agriculture. Aquaponics (AP) combines two technologies: recirculation aquaculture systems (RAS) and hydroponics (plant production in water, without soil) in a closed-loop system. One challenge to the development of this technology is the conversion of the toxic ammonium produced by the fish into nitrate, via bacteria in a biofilter, to provide nitrogen to the plants. However, as this Special Issue shows, there are many other challenges that need to be addressed if the goal of the technology is to contribute to more sustainable food production systems.

Urban Heat Island: Causes, Effects and Mitigation Measures - A Review

High temperature in the city centers than its' surroundings known as the Urban Heat Island (UHI) effect, which is causing discomfort to the urban dwellers in the summer time is gaining much attention around the world because the world is getting urbanized as it advances in technology. Alterations of surface area, improper urban planning, air pollution, etc. are causing this increasingly growing phenomenon and itis accountable for human discomfort, human casualties and decline of climate. In this paper, an attempt has been taken to review various measures to encounter UHI effect and the processes by which these strategies work is described with diagrams. Using high albedo materials and pavements, green vegetation and green roofs, urban planning, pervious pavements, shade trees and existence of water bodies in city areas are the potential UHI mitigation strategies on which discussion is done in this paper with their limitations. Green vegetation seems to be the most effective measure and other strategies can play a major role under proper condition.

III.HEATING ISLAND EFFECT



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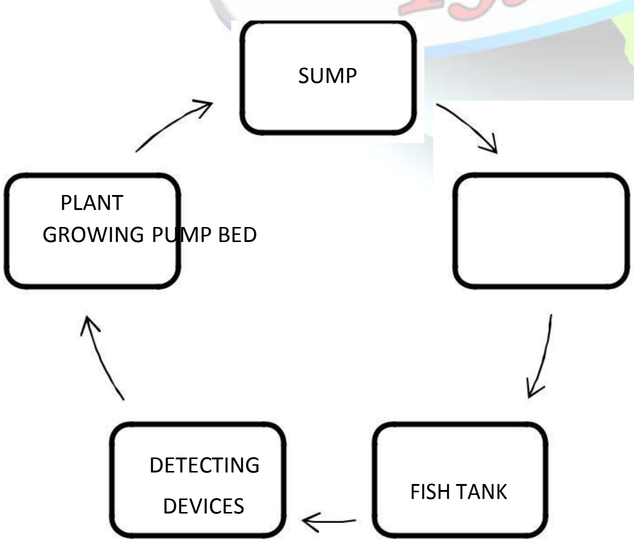
The elevated temperature in urban areas as compared to rural, less developed areas is referred to as the urban heat island effect. As cities grow and develop, more buildings and people are added. The process of urban development leads to this phenomenon. For smaller cities, heat islands are less noticeable. For a large city of one million people, the average temperature can be anywhere from around 1°C to 12°C warmer than the surrounding area. This may not seem significant at first, but over time, these increases can cause major problems.

IV. PROPOSED SYSTEM

The existing aquaponic system consists of a source for water supply, a fish tank, a grow bed along with the connecting lines. There involves certain equipment for the detection of p^H, temperature monitoring, water flow regulation, etc. The water can be regulated to flow through the growing beds(pipelining in case of vertical mounting systems). This water is utilized by plants. The water from the growing bed is again made to go to the sump. Thus there exists a cyclic process of circulating the water throughout the system.



The above mentioned diagram shows the cyclic process involved in aquaponics. the arrow marks indicate the flow of water in the system. The system requires a continuous supply of water from a well or from a sump which is pumped out into the fish tank. The fish tank involves the culturing of various species of aquatic animals which supplies a lot of excretory waste in the water. The excretory waste of fishes is rich in ammonia-a compound of nitrogen. This is utilized by plants after the process of nitrification. The process involves the breaking down of ammonia into nitrites and nitrates with the help of nitrifying bacteria using the bio-filters. This filter also prevents the entry of solid wastes into the plant growing section. The plants which are in need of nitrogen compounds utilize that for their growth. The remaining water from the growing bed is pumped out back to the sump which can be utilized again. The other requirements for the successful working of an aquaponic system are the maintenance of p^H level in water, maintaining the temperature level suitable for the fish growth, stand pipes that support the flow of water, a suitable surrounding which enhances the yield. The vertical mounting system mainly involves the installation of the growing beds in vertical position. Thus this makes our idea powerful. The pipelines (growing beds) can be installed over the roof of the building and also at the side walls. Since there exists a continuous supply of water, the temperature of the interior building and also the surrounding gets gradually reduced. Thus this reduces the island heating effect. Since this does not require any additional land for making

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gardens, it will be highly recommendable. The system does not require much water as the water once utilized is reusable. Since it completely does not depend on soil for growth, the risk of soil erosion or some damages due to soil oriented problems can be reduced totally. The risk of increased temperature will be reduced abruptly. This supports the dwellers to grow their desired crops in their home by themselves without depending on soil. The pipelines for the growing bed have to be installed without disturbing the natural ventilation and aeration to the building. Since the plants are grown just at the door steps, the increased supply of oxygen makes the rooms fresh and makes the mind of people inside it calm. This also helps the people to get double income by selling vegetables and fishes at a time. Since there is no toxicity produced, this system supports for the development of a green society and a healthy environment.

V. CONCLUSION

The aquaponic system supports economically by providing money in form of fishes, vegetables, fruits, etc. this serves commercially by satisfying the demand for food. This again helps for the sustainable development of the nation's gross domestic product. Though this is an emerging technology, this has a great scope in neutralizing the food supply in future. This mainly helps in reducing the heating effect through its efficient water circulating mechanism.

VI. FUTURE SCOPE

The only drawback in this system is that not all varieties of crops can be grown through this method. Hence, more researches in this field contribute the well development of this method in future.

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