Aquaponics Agriculture for Large Scale Irrigation System

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Abstract - *Due to huge demand on water resources and subsequently affects the food production. New technologies in agriculture tends to tackle the complexity of production system. From agri-science trending ponics system are aquaponics, Hydroponics, Aeroponics. Aquaponics is bio-interlinked system which recirculates water from aquaculture to hydroponics. It makes revolutionary transition to organic production, vertical urbanism gives basic principle of aquaponics system. By adopting this dynamic method to commercial based urban agriculture, industrial state production in rural areas and enhancing small scale to large scale can develop the country. Possibility to increase economical and sustainable efficiency can be achieved by using this principles. From RAS toxicity of ammonia can be reduced. In this paper for large scale irrigation process the canal irrigation in the form of conventional irrigation can be modified in the form of aquaponics agricultural irrigation system. Where the main canal serve as an aquaculture system and the irrigation fields serves as a hydroponics system. For further research, by placing the working model in schools that makes an involvement with this and helps the students to bring up with some innovative ideas in aquaponics agriculture for large scale irrigation. By implementing automated system aquaponics agriculture will become an ideal system.*

Keywords: **Aquaponics, Hydroponics, Aquaculture, Canal irrigation, Organic Production, Recirculating system Urban Agriculture.**

1. INTRODUCTION

"**Let's feed our agriculture**" this word says in current situation of agriculture, everyone knew that our agriculture rapidly getting down from that grade. Water is essential source for agriculture and it would be the universal need of all living beings. This basic requirement also now depleting. Even in some place there is no possible to recharge the water resource. This main factor, it is purely depend on how utilizing the resource and recirculating the water. In the stream of agriculture due to huge demand of water quantity it tends to affect the agriculture. By considering the factor agriculture rank can be increased, by implementing new technologies which may replace the conventional agriculture or may involved in changing procedure of conventional agriculture system.

Because of huge demand on water resources subsequently affect the food production. In order to avoid this situation recycling of water is the effective method to save water resource and agriculture. It was already described in sangam literature about recirculation of water.

Types of ponics agriculture: From agri-science, the trending ponics systems are,

1. Hydroponic system, 2. Aeroponics system
2. Aquaponics system

Hydroponics system:

In this method, food production is done by the plants, where they grown in rich nutrient solution without soil medium. Hydroponic system can be adoptable for outdoor groups. In the hydroponics, hydro indicates to water and ponos indicates labour i.e, water works for plant growing without the help of soil medium.

Aeroponics system:

In Aeroponics system plants roots are constantly or intermittently kept in a controlled environment. It is the process of growing plants in an air or mist environment without use of soil medium. Unlike hydroponics system, the nutrient rich water is sprayed over the roots.

Aquaponics system:

Aquaculture + hydroponics = aquaponics

Where,

Aquaculture : Terminology of production of aquatic species (Fishes)

Hydroponics: Terminology of production of plants without soil medium.

Aquaponics : Terminology of production of both aquatic species and plants   without using soil medium.

Aquaponics is an interlinked bio-controlled system, it consist an elements of aquaculture and hydroponics, where nutrients enriched water from aquaculture is recirculated to the hydroponics plants for growth and again recirculated into aquaculture. In an ancient practices using of fish waste is getting up into further step.

Conventional forms of aquaponics: Stationary islands: In this type of system islands are formed centre of the natural aquaculture system where water from natural resource pumped into islands for agriculture.

Introduction of fish into paddy: In this system fishes are allowed to live in cultivable lands for agriculture.

From aquaponics agriculture urban environment can help the agriculture for the revolution. However rural environment undergoing to conventional farming it gives clear route way to upgrade the level of agriculture.

Major resources for agriculture cultivable areas, freshwater, nutrients. In present scenario, the resources also getting depletion. It forced as to limited usage. This drawbacks are from first step for agri-science to invention of aquaponics agriculture.

The inter-loop of aquaculture and hydroponics systems give way to ensuring food production in sustainable form. Nutrient transfer from aquaculture to hydroponics permits considerable amount. The transformation of nutrient allows the reduced use of water quantity. The conventional aquaculture need not required the periodic exchange of water in aquaponics system.

Principle of aquaponics:

Aquaponics is combination of hydroponics system and aquaculture system. In conventional hydroponics system plants required some mineral fertilizers. In conventional aquaculture system the water required periodical change, by combing these two systems into a bio-controlled looping formation the requirements of addition of mineral fertilizers and exchange of water is satisfied.
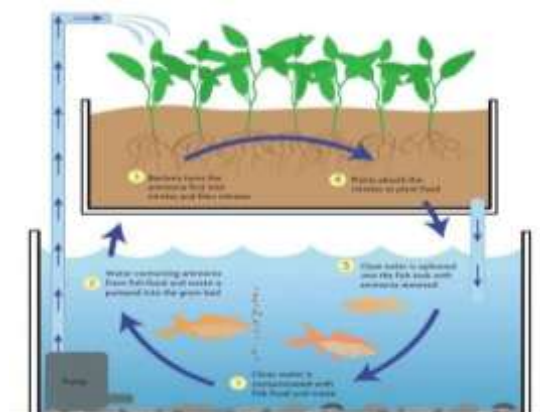

Fig - 1 Process of aquaponics

2. EXISTING SYSTEM

Large amount of fresh water and fertilizers have been used in conventional agriculture. In canal irrigation system the water controlled by canal head work and discharge particular amount whenever it need in the main canal from river

stream or other water resources. From that main canal system water distributed through its distributaries to branch canal and irrigation fields. In this canal irrigation system two types are generally classified based on lining system in main canal. One is lined canal and the another one is unlined canal.

Both of these systems are used in conventional irrigation system. In conventional irrigation system wastage of water is more that is the quantity of water from canal head work is highly varies from the amount of water entering into the irrigation field. Canal irrigation has different modes of irrigation system….

In practical aquaponics system implemented in roof and walls of the building, gardens and balconies in the form of small scales. Aquaponics are also implemented in the formation of in door and out door farming. The green house systems provides the precise appearance of agricultural technology. Aquaponics implemented with this beds of nutrient film technique, deep water culture and media based system. These systems are made in small scale racked system or inside the green house system.

3. PROPOSED SYSTEM

Large scale application of aquaponics system has not been reached a successful popularity and the concept is very complex so that people find difficulty to understand the concept of aquaponics like what is happening in aquaponics. Aquaponics can also applied in large scale system but it requires more investment to get an effective aquaponics system. This paper speaks of explaining the idea of aquaponics in terms of conventional methods of irrigations like canal irrigation.

In this project the conventional canal irrigation system is modified for the large scale implementation of aquaponics system. Where all the limitations and applications are considered to implement in large scale system by modifying the conventional irrigation system. For large scale irrigation process the canal irrigation in the form of conventional irrigation can be modified in the form of aquaponics agricultural irrigation system. Where the main canal serve as an aquaculture system and the irrigation fields serves as a hydroponics system.

Here the main can has the ability to serve as aquaculture system by receiving large amount of water from canal head work. At the same time the nutrient rich water has been produced by fishes in main canal is discharged to irrigation filed. After the process of uptake by plants the discharged water received by collecting system. Then the water again recirculated into main canal with proper controlling of water quality parameters. In irrigation field racking system also applicable by using this method.

Prototype of aquaponics system is made for the observation of behaviours of both plants and fishes. Materials are collected depend on their suitability and availability conditions. The need for this paper discussion is based on the consideration of economic and environmental considerations.

3.1 NEED FOR STUDY

1. Agriculture should not only depend on rural environment also depend on urban environment.
2. The aquaponics system reduces the large land requirement than conventional agriculture.
3. Conversion of nitrate is less toxic to aquatic organisms than ammonia where produced in aquaculture.
4. For minimizing the use of soil during plants growing.
5. To improve the principle of vertical urbanism.
6. The usage of water in conventional agriculture and aquaculture can be reduced by introducing aquaponics system.

4. REQUIRED MATERIALS TO PROTOTYPE FOR PROPOSED SYSTEM

Deep water culture: Cabbage, Ladies Finger, Tomato.

Media based system: Cabbage, Pulses

Media: pebbles, coco coir, sand

Tank size: 1mX1mX0.3m: Tank type: glass tray

Glass thickness: 8mm: Situated height: 1m

Fish types: sharks and koi carp:

Food type: floating food: Tank capacity: 150 litres

Pump capacity: 30 watts

Pipe material: PVC: Pipe size: ¾ inch

4.1 SELECTED AQUAPONICS BEDS

In this project, among three types two types of this adopted.

1. Media based system, 2.Deep water culture

Reasons:

1. Media based system is adopted for quicker filtration process for nutrients.
2. Deep water culture is ease of maintenance and cleaning process.
3. In constant flow method is useful even in the quantity of nutrient in lower amount where presence higher pH level.
4. In deep water culture and media based system the nutrient uptake speed is high.

5. SET UP DESIGN:

Fig - 2 Initial set up

Fig -3 Final set up

5.1 REQUIRED FLOW TYPE

1.Reciprocating flow: In which the hydroponic system alternatively flooded and then drained on regular basis.

2.Constant flow: In which the flow at constant rate for 24 hours.

6. BEHAVIOUR OBSERVATIONS

6.1 Sowing of seeds:

In media based system pulses seeds, tomato and cabbage are decided for sowing process. The plantation bed is divided into two segments one for deep water culture and another one for media based system. To held sowing process for hydroponics system net pots are adopted to support the saplings on hydroponics bed.

Fig -4 Sowing of seeds for media based system

This filled medium used for initial grow for seed for saplings. After that expanded polystyrene used as a bed for hydroponics. On this expanded polystyrene bed holes are made to place the net pots with saplings. During this placing process filled materials are removed from net pots and the cleared plant with roots are placed.

Fig -5 Sowing seeds for deep water culture

6.2 Growing stages:

The observations are done from the initial stage to growing stage. This behaviour observations done for both aquaculture and hydroponics system. The plant growth observed certain interval of days.

Fig -6 Growing stage 1

Fig -7 Growing stage 2

Fig -8 Growing stage 3

Fig -9 : Growing stage 4

Fig -10 Growing stage 5

7. MAINTENANCE OF WATER QUALITY

The obtained results of parameters of the water quality were checked, weather the quality is under the desired range of fish culture or not throughout the observation. Fishes produce the waste which contains ammonia. When it exceeds its optimum level it will be toxic to aquaculture. Subsequently the pH level increased without any indication it may rise or fall at any time. Due to that tests were conducted for both ammonia and pH level. The initial water from tap is filled with aquaculture tank and taken for the test. Which shows the range of ammonia and pH level as 0 ppm and 7.04 respectively.

For both ammonia and pH parameters they were maintained at optimum level through-out the experiment. When the ammonia level exceeds its allowed to flow through the hydroponics system for about one day and the it provide the result within the limit after testing.

7.1 Ammonia and pH test results

S.No	Date	Ph	Ammonia (ppm)	
			Before	After
1	04:02:2019	7.04	0	0
2	11:02:2019	7.22	0.18	0.12
3	21:02:2019	7.71	0.24	0.16
4	04:03:2019	8.07	0.30	0.10
5	11:03:2019	8.13	0.28	0.18
6	18:03:2019	7.6	0.32	0.21

8. CHALLENGES FACED

For an effective aquaponics system the following factors have to be maintained. They are ammonia, pH, phosphorus and free from animal intrusion.

Ammonia level

Ammonia is the waste that are produced by the fishes, the level of ammonia get increased day by day due of accumulation of waste from the fishes, if it exceed the level which may affect the fishes it may leads to death of marine species. Normally the level of ammonia in the fresh water is 0.25 ppm. In every aquaponics system has the main objective of zero-discharge of water. To attain the objective ammonia level has to be maintained at optimum level.

pH stabilization

pH stabilization is the crucial point in aquaponics system. It is critical for all living organisms like fishes, plants and bacteria. The optimum level of pH is vary to each stage of aquaponics system. The value of 6 - 6.5 helps to increase the uptake of nutrients. The degree of pH rate adjusted by flow rate of water in this system. The optimum level of pH in aquaponics system is 7 – 8.

Animal attacks

Due to placing the aquaponics system in external exposure it easy to approachable by other animals. During day time system has been maintained in proper manner. But during night time because of fish habitats leads to attract the animals like cats, etc. After four days from placing the aquaculture system few of fishes dead by those animals. So that new fishes replaced the dead fishes.

9. CONCLUSION

This project interprets the detailed implementation and observations of aquaponics system. Thus the aquaponics system is serve as a model for canal irrigation for large scale agriculture.

From this paper the deep water culture and media based system were observed and produced result as media based system has higher growing than deep water culture. The aquaculture and hydroponics equivalence rate is good enough here to produce nutrient rich water as well as recirculation water to aquaculture. Due to interconnected characteristics of aquaponics it can be an application for both low level and high level technical implementation. Based on literature reviews this paper demonstrates that the balancing rate of aquaponics system, water quality parameters and study about environmental conditions can help to assess the efficiency of this system. The balancing rate depend on type of fish and their food feeding rate, production of ammonia level, hydroponics type, density of plant sowing, type of aquaponics beds. From this type of agriculture method implementation both rural and urban environment can serve sustainable food production directly to the consumers.

Scope of the project:

1. Canal irrigation will face the new technical system while adopting large scale irrigation.
2. Ammonia and pH sensors can make automated aquaponics agriculture system.
3. Crop per hectare can be increased in terms of land use.
4. This Bio interlinked system facilitates the organic food production.
5. Many forms of this can make aesthetical view for tourists.

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