Hydroponically Growth of Saffron *(Flow ebb Vertical System 530x155 ft)* Concept to Design

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Abstract: Agriculture outlooks as backbone in Pakistan economy. In spite of being important, it faces challenges from production to financial incompetence's. Pakistan agriculture is raged by several problems such as meager farm equipment's, lack in quality toolsets, unusual monsoons or outbreaks of pest. Hence, hydroponics agriculture production system gives promising yield round the year. And also, this system is commercially scalable and adaptable by all sectors of people. We can either start as small green house system in home or to a highly productive industrial scale. The paper proposes one such home based hydroponics system for Safforn plants. Hydroponic saffron can be grown easily. Growth of hydroponically saffron, grower can be earned extremely high price in every year. Saffron is among the most expensive. It has been known to be an extremely high priced spice since the 7th century. Another thing is that we will have to grow saffron 4 times a year to ensure we are getting the highest yield possible to maximize profits. Usually, saffron takes 2.5 to 3 months from planting to reaching the harvest stage. Moreover, using hydroponics can speed up the growth rate so that you can produce a higher yield when compared to using soil.In order to collect one pound of fresh saffron, we will need to collect around 200,000 stigmas from approximately 70,000 saffron flowers. Which is only possible through hydroponically growth system To achieve this system, we must develop a controlled environment to check all the parameters of natural resources and use them according to their needs and quantity.

Keywords: Sustainable production, Hydroponics, Nutrient solution, IoT,

INTRODUCTION

Pakistan is expected to reach world's highly populated country in forthcoming decades overtaking china with a growing population of about 1.37 billion. This human resource has helped us to build our economic growth of the country, projecting India as fifth largest one in Gross Domestic Product and third largest one in purchasing power. Agriculture is a good contributor for our Indian Economy. It accounts about 18 % of India's gross domestic product (GDP) and up to 50% work force of the countries. However, most of the Indian population is directly or indirectly contributing to agriculture. Directly refers to farming and indirectly is by agriculture based business sectors. Though agriculture sector serves good for our Indian economy, we are in demand to feed many mouths in the future. To meet this demand, India needs to move to increased agricultural yields or by importing its food requirements. Imports on food products would make the growth of Indian economy more costly. In day to day human consumption products, India exports rice, wheat, spice, and spice products and imports fresh veggies, fruits. To overcome this, an alternative farming techniques need to be adopted for growing veggies and fruits. One such promise able

alternative farming technique is hydroponics method of cultivation [1]. In hydroponics system, plants could be grown by flooding their roots with the nutrient solution. In case like plant with thick stem is supported with mediums like alluvial soil balls or gravels. The nutrient solution is either prepared from natural by products or created artificially by blending micro and micro nutrients. [2]The plant is nurtured with nutrient solution which comprises of macro nutrients like N,K,P,Ca,S,Mg and micro nutrients such as Ni,Cu,Zn,Fe,B,Mn. The absorption of the nutrient concentrate is higher in hydroponics when compared to traditional system. Commercial Hydroponics system is being established by techy-entrepreneurs across various cities in India [10]. It stretches from Herbivore farms from Mumbai to Jnga –fresh green in Shimla, Triton food works in Delhi, Nature's Miracle in Noida, LetcetraAgritech in Goa and Future Farms in Chennai [11]. The agri-entrepreneurs of hydroponics system state that it is most advantageous method in respect to its scaling nature, non-dependency of weather, minimal water utilization and zero pesticide-free yields to reach global standards [12]. II. RELATED WORKS Hydroponics is established in different models like continual-flow system, Ebb & flow system, drip system and nutrient film technique. The paper [3] "Nutrient Film Technique (NFT) for Commercial Production" by Stephanie et al., demonstrate NFT model prototype of hydroponics farming from concept to design.

The NFT system is costlier due to its installation process. In order to compensate the cost, it needs to be backed up with technology to make improved production from the system. In-door hydroponics is an idea of adding another feature to the cap. In this method, total light intensity, duration and color of LEDs is authorized by the cultivator. [4] Shreya et al., in their paper "IoT based Automated Hydroponics System" discuss about cost-efficient system by controlling it through internet of things. The authors of the paper introduces LED light source for hydroponics plants in indoor farming systems and in unusual climatic conditions. [5] Namagel et al., in their paper "IOT based hydroponics system with supplementary LED light for smart home farming of lettuce" has proved the provision to alter the light source with respect to plants growth rate. [6] Nathaphon et al., in their paper "Optimal Plant Growth in Smart Farm Hydroponics System using the Integration of "Wireless Sensor Networks into Internet of Things" spot out the automation of controlling devices like sensors and actuators in hydroponics system through WSN. The Technology adopted in hydroponics system helps to measure intensity of light source, water utility, temperature and humidity and PH value of the nutrient water. [7] Charumathi et al., in their paper "Optimization and Control of Hydroponics Agriculture using IOT" excavates all the data from various sensors like light, humidity, PH value and temperature. This accumulated data is taken for generating intelligent decisions to enhance the growth rate by controlling the growth parameters. [8] Anuradha et al in their paper "Decision Support System for Smart Farming with Hydroponics Style" strongly suggests the importance of monitoring PH values and NPK values periodically. These monitoring data helps the user to take post operation decisions for building strong interactive IOT system through machine learning algorithms. [9] Raj Kumar et al., in the paper "A Novel Approach for Smart Hydroponic Farming Using IoT" coins user defined hydroponics farming system by Blynk App and instant data logging by Thinkspeak. The hydroponics farming could be commercially viable for profitable veggies such as Lettuce. The paper [13] "Design and Development of Solar Powered Smart Hydroponic Greenhouse" by Parth Varmora et al., quantifies a NFT design with solar powered function unit for reliable power source. Sustainable hydroponics system is technologically defined by decision making parameters. In the paper [14] "IOT based smart system to support agriculture parameters: A case study" by Abhijit et al., introduces Cuckoo search algorithm based farming conditions with cultivating parameters like temperature, PH value, moisture content. These data will help us to take precision of farming. Precise farming is the governing force for high expectation yields. The paper [15] "Intelligent monitoring and controlling system for hydroponics precision agriculture" by Herman and Nico Surantha pitches idea on precise control of water and fertilizer for lettuce plants. The data acquired is governed by cloud - based services. This method is stated in the paper [16] "Internet of things using Publish and Subscribe Method for cloud - based application to NFT-based

hydroponics system" by Muhammad Agus Triawan et al. The next big thing in technology is Artificial intelligence. It stretches its roots in all potential sectors where intelligent decision making is a costlier one. The paper [17] "IOT based hydroponics system using deep neural network" by Manav Mehva et al., in their paper have broadly presented about the application of deep neural network in hydroponics method of cultivation and decision making on growth conditions through machine learning.

Hydroponic Saffron

Hydroponic saffron can be grown easily. Growth of hydroponically saffron, grower can be earned extremely high price in every year. Saffron is among the most expensive, if not the most expensive spice out there. It has been known to be an extremely high priced spice since the 7th century. Another thing is that we will have to grow saffron 4 times a year to ensure we are getting the highest yield possible to maximize profits. Usually, saffron takes 2.5 to 3 months from planting to reaching the harvest stage. Moreover, using hydroponics can speed up the growth rate so that you can produce a higher yield when compared to using soil.

In order to collect one pound of fresh saffron, you will need to collect around 200,000 stigmas from approximately 70,000 saffron flowers. Which is only possible through hydroponically growth system.

SAFFRON GROWTH CONDITIONALITIES in HYDROPONIC

- NFT vertical growth system.
- Average saffron plant can grow to reach around 8” to 12”.
- Growing period of 3 months.
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- TEMPRATURE 60 -70 F or 15- 20 Celsius, to keep the temperature at 65°F most of the time. It has been proven that this temperature ends to highly stimulate the saffron to flower. If the temperature exceeds the 75°F for long periods of time, it can result in flower abortion.
- PH of 5.5. Moreover, the EC should be 1.4.
- Nutrient including crocus bulbs, prefer heavy phosphorous and potassium for good growth, and just the right amount of nitrogen. The change in nutrients will induce more production of safranal—the organic compound responsible for the aroma of saffron.
- Any nutrient solution should contain all the necessary elements: N, P, K, Ca, S, Mg, Fe, Mn, Zn, B, Cu, Mo but with higher concentration of Phosphorous and Potassium. This is basically how bloom formulas are based. Dilution as per manufacturer’s instructions.
- Kashmiri type from Odyssey Bulbs.
- Electricity cost is very high, growing saffron flowers in these quantities will significantly boost your electricity bill at the end of the month. Because saffron need light 14-16 direct light and 12-14 hours light in day. Similarly Air pumps, water pumps, and climate control systems will also consume a tremendous amount of electricity when combined together.
- Labour cost is also remained higher and it is around 180 of continuous labor hours during the harvest stage.
- Harvesting The Hydroponic Saffron harvesting 675,000 saffron bulbs can be extremely overwhelming if not done properly. When the harvesting season begins at the end of each growing cycle, you must know a very important fact. The stigma threads in the middle of a saffron flower are the most important part of the entire plant.

- Drying And Storing Hydroponic Saffron, after collecting the stigma threads, you are now left with another critical job, which is drying and storing the saffron. Fresh saffron stigma threads must be dried well to get a high-quality final product. There are several methods to dry saffron threads, one of them is dehydration under temperatures.

- Dehydration with high temperatures can be done by placing the saffron threads in a sieve and heat them over a gas stove at 122 – 176°F for 30-60 minutes. This process must be done until the moisture reaches a maximum of 5-15%.

- After that, you should store the saffron in airtight plastic bags. If the bags aren't tight enough or the dried saffron moisture is above 15%, fungi can spoil it in a matter of days.

- The effect of three different weights of corm (6-8, 8-10 and more than 10 g) and also three different densities of corm (50, 100 and 150 corms per m2) was investigated in factorial experiment based on CRD with three replications. The traits which were investigated included: number of flower, fresh weight of flower, fresh and dry weight of stigma and style, biomass and economic yield. The results showed that the main effects of cultivation systems, weight and corm density were significant in all traits. The heavier corms (more than 10 g) provided the highest yield. By decreasing corm weight, all traits were reduced significantly. Also the result showed that increase in yield (dry weight of stigma) was obtained under soil cultivation and in the density of 150 corms/m2 equivalent to 7.38 kg/ha economical saffron.

HYDROPONIC SYSTEM

Hydroponic tomatoes are grown in a nutrient solution rather than soil, although they are typically placed in a non-soil material that can support their roots and hold the nutrients. Hydroponically grown vegetables can be just as nutritious as those grown in soil. ... Plants make their own vitamins, so vitamin levels tend to be similar whether a vegetable is grown hydroponically or in soil.

Hydroponic plants grow 25-30% faster than traditionally grown plants because the perfect blend of nutrients is delivered directly to the root system. The plant does not need to expend energy on an extensive root system to find the food it needs, so all of its energy goes into upward leaf growth.

The main advantages of the greenhouses and hydroponic are:

- Good distribution of light inside the greenhouse. The greenhouse covers have the ability to change the direction of the sun's rays, thus evenly distributed over the entire surface, benefiting the entire greenhouse and avoiding the sun's rays directly to the plant.

- Energy efficiency. Takes advantage of the environmental conditions, such as optimizing the heat/cooling inside the greenhouse.

- Control of microclimate. One of the main **advantages of a greenhouse** is to control and establish the optimal environment for cultivation. We can adjust the temperature, humidity, lighting, etc.

- Protection against diseases, pests and other vermin. Another **advantage of a greenhouse** is that it is very difficult to enter as it is a closed space.

- Excellent ventilation. You can ventilate the greenhouse quickly, thanks to their zenithal or side windows.

- Optimum sealing against rain and air.

- Increased production. There are a great **advantage of a greenhouse**, can intensify production due to weather conditions, can accelerate the growth of the plants and also allows a greater amount of crop on the surface.

- Production off-season. The environmental control of the greenhouse can produce off-season, therefore we will have a better sale price and a continuous supply of the product.

- Production in regions with adverse weather conditions.

- Ability to grow all the year and maintain crop cycle per year and different species of plants.

- Optimizes the use of other technologies to facilitate the management of climate (heating, humidification, shade screens or saving energy, etc.)
- When Compared To Traditional Soil-Grown Crop Production, Hydroponics Has the Following Advantages: Up to 90% more efficient use of water. Production increases 3 to 10 times in the same amount of space. Many crops can be produced as fast in a well-managed hydroponic system.
- Hydroponics growing uses mineral nutrient solutions to feed plants that are growing in water, so no soil is used in the process. Hydroponically farming profitable is the most profitable venture plants to grow and sell, no problem making money.

THE ECONOMICS

Mathematic of production calculation
To get 1 lb. of dried saffron threads, you have to harvest the stigmas of around 67,500 Crocus Sativus flowers. This means that in order for you to get around 10 lb. of dried saffron per season, you have to grow 675,000 Crocus Sativus bulbs. To attain 675,000 flower bulbs can be overwhelming, and it is actually a huge number of flowers.

Every saffron plant can grow up to 4 flowers per spot. But when it comes to numbers, in order to avoid error if calculate conservatively, so, assume that every saffron plant will result in an average of 2 flowers per spot.

675,000/2 Flowers Per Spot =	337,500 Spots
337,500/72 spots =	4,687 Units

Every Flow EBB unit takes an average of 4 ft. square of a growing area. To save as much space as possible, we must implement vertical farming designs. If we used traditional hydroponics to grow 675,000 saffron bulbs every 3 months, it will require an extremely large growing area. Vertical farming to grow 3 levels of hydroponic saffron in order to save space. Moreover, saffron is a plant that can easily be suited in a vertical hydroponic system because of its short height. An average saffron plant can grow to reach around 8" to 12". Saffron has a growing period of 3 months to reach the harvest stage. So, as I have mentioned before, we are going to grow it 4 times per year

The proposed system is 530 x 155 FT vertical with 4 levels mean 8 growing gutter 10.6x4x4 FT.

NUMBER OF PLANTS:

Description	Details
AREA	530 x 155 FT or 82150 SQFT
Structure FLOW EBB	L 18 x W 4x H 10.6 FT
Number of plant	956,160
Number of flower	1,912,320
Stigmas	Collect around 200,000 stigmas from approximately 70,000 saffron flowers.
For one pound saffron	67,500 flowers from 675,000 saffron bulb
Production	113 pound 0r 53 kg

Project Technical Note

Description	YERA1	YEAR 2	Year 3	Year 4	Year 5
Revenue	80,668,000	88,734,800	97,608,280	107,369,108	118,106,018
Operation	8,590,157	9,449,172	10,394,089	11,433,497	12,576,846
GP	72,077,843	79,285,628	87,214,191	95,935,611	105,529,172
Market com	8,066,800	8,873,480	9,760,828	10,736,910	11,810,601
Admin	175,000	192,500	211,750	232,925	256,217
Before tax	63,836,043	70,219,648	77,241,613	84,965,776	93,462,354
Income tax	6,383,604	7,021,964	7,724,161	8,496,577	9,346,235
Land tax	45,000	45,000	45,000	45,000	45,000
Net income	57,407,439	63,242,684	69,472,452	76,424,199	84,071,119

- Hydroponically growth of Saffron Bulb weight should be around 15-24 GRM. ONE TIME SPENDING

Bulb can reuse after the age of 6 Month or less.

- Every plant bulb produced 3-4 bulb in every harvesting.
- Along with stigma ,bulb also sold PKR 150 /bulb

PRICE IN LOCAL MARKET

Variety Available	Min Price
American Saffron	Rs 20000/Kg
Kashmiri Saffron	Rs 79/Gram
Natural Saffron	Rs 79/Gram
Natural Saffron	Rs 68000/Kg

Max Price
Rs 100000/Kg
Rs 520/Gram
Rs 260/Gram
Rs 200000/Kg

Description	Details
SEEB BULB 15-24 GRM Bulb, golden brown	7,808,000.00
Fertilizer	667,900.00
Nutrient supplement	175,900.00
Electricity 756KV lights +20 + 61 units	6,097,140.00
Water 19,920 gallon RO WATER	425,888.00
LABOUR 1+1	576,000.00
SEASON LABOUR	340,000.00
DRY UNIT	45,800.00
PACKAGING PER GRM PACKAGING	173,529.00
TRANSPORTATION	96,000.00
TOTAL :	16,406,157.00
OPERATION COST	8,590,157.00/YEAR

In the international market price is USD 5000 to 12000/ KG

PRODUCTION COST

The production is very high due to usage of constant light 14-16 hours along with other operative equipment's.

- GROWING LIGHT 57 KV/HOURS X14 HOURS = PKR 5,715,360.00
- PUMPING EQUIPMENTS 20 KV 151,200.00
- OTHER EQUIPMENT 6 MONTHS PKR 230,580

REVENUE CALCULATION

Description	Details
Kashmiri Saffron	PKR 620/GRM
Production	53 KG
Revenue	32,860,000.00
Bulb revenue	47,808,000.00
GP	80,668,000.00

5 years Estimations

GROWING MEDIUM

Description	Details
Coco coir, perlite, vermiculite, coco hast	11,500,000.00

Saffron plants cultivated hydroponically for six weeks produce corms that exhibit significantly less fresh weight increase as compared to plants grown in soil. However, the dry weight of hydroponically grown corms is significantly greater than that of soil-grown corms. Professionals in this industry ranked Saffron as the most expensive spice. Anyway, saffron price depends on the saffron quality and for 1 Kilogram it costs 3500 to 160000 USD.

Indeed, for people that don't have enough information about saffron, there is a question about saffron price: "Is it the Saffron Oil, Powder, or Threads price, there is different types of saffron threads those are offered with different prices. There are different types of saffron threads. And these thread is transfer in value addition like saffron oil and saffron powder.

PROPOSED SYSTEM FEATURES

FLOW & EBB VERTICAL SYSTEM

- Proposed system L 18x W 4x H10.6
- 1495 systems
- Flow & Ebb tables 7470
- Growing light
- Fertilizer system
- Water controlling system
- Water distribution and recycle system
- Ventilation system
- Water circulating Cooling system
- Ground cover
- Aluminum shading
- Structure inside with aluminum or GI pipe
- Civil

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