



UTILIZATION OF FISH FARMS WATER FOR VEGETABLES PRODUCTION

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ABSTRACT

Aquaponics is the combined culture of fish and plants in recirculating aquaculture systems, considered to be an innovative, eco-friendly and sustainable technology. So, the main aim of this work is to investigate to which extent the content of nutrients in water discharged from fish farms is sufficient for growing lettuce plants, in order to reduce the using of chemical fertilizers, save water, improve the plant and fish. To achieve that, two nutrients sources (effluent fish farm and stock nutrient solution), three systems of hydroponics (deep water, A shape and gutter systems) and three flow rates are 1.0, 1.5 and 2.0 L h⁻¹ per plant were compared. Also, water use efficiency of lettuce plants was determined. The various water quality parameters and plant growth were studied for treatment under study. The obtained results indicated that the highest values of N, P, k, Ca and mg consumption rate were found with gutter hydroponic system and 1.5 L h⁻¹ plant⁻¹ of flow rate for lettuce plants grown in nutrient solution. The highest value of the length of root (26.93 cm) was found with waste fish farm for deep water hydroponic system. The fresh weight of whole plant for lettuce plants grown in gutter hydroponic system was better than those grown in different culture system. The fresh and dry of shoot and root for lettuce plants grown in gutter hydroponic system was better than those grown in different culture system with 1.5 L h⁻¹ plant⁻¹ flow rate. The water consumption and nutrient solution consumption by lettuce plants grown in A shape hydroponic system was more than those of Gutter and Deep water hydroponic systems. The highest value of the water use efficiency of lettuce plants was 46.11 kg m⁻³ was found with nutrient solution for gutter hydroponic system. The highest values of N, P, K, Ca and Mg uptake were 2.86, 0.85, 3.20, 1.90 and 0.30 %, respectively, for all treatments. The total weight gain, fish growth rate and specific

growth rate were 138.9 g, 2.78 g day¹ and 2.03 %, respectively. The total production costs of lettuce plant at the end of experimental period in stock nutrient solution and effluent fish farm were 1.60 and 1.03, 1.89 and 1.36 and 1.30 and 0.87 EGP plant⁻¹ for A shape, gutter and deep water hydroponics systems, respectively. The model results were in a reasonable agreement with the experimental ones.

Keywords: Aquaponic, Aquaculture, Hydroponic, Fish, Lettuce plant, Nutrients, Water use efficiency, Root, Shoot, Weight gain, Costs.

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LIST OF ABBREVIATIONS

| | |
|----------------------|------------------------------------|
| AC | The amount of chemicals. |
| AF | The amount of fertilizers. |
| AP | The chemical price. |
| BOD | Biological oxygen demand. |
| CHP | Combined heat and power. |
| COD | Chemical oxygen demand. |
| D_c | Depreciation costs. |
| DO | Dissolved oxygen. |
| DWC | Deep water culture. |
| E | The energy costs. |
| EAF | Ebb-and-flow. |
| EC | Electrical Conductivity. |
| E_c | The electrical energy consumption. |
| EFW | Effluent fish water. |
| EP | The energy price. |
| F&D | Food-and-drain. |
| F_c | Fixed costs. |
| F_c | Fertilizers and chemicals costs. |
| FCR | The feed conversion ratio |
| FER | The feed Efficiency ratio. |

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| FGR | The fish growth rate. |
| FP | The fertilizer price. |
| HDF | Hybrid-denitrification filter. |
| HVP | Hydroponic vegetable production. |
| I_n | Interest costs. |
| IRR | Internal return rate. |
| L_a | Labor costs. |
| LAI | Leaf Area Index. |
| NFT | Nutrient film technique. |
| NPV | Net Present Value |
| NS | Nutrient solution. |
| P.B.P | Payback period. |
| P_m | The purchase price of the system. |
| PVC | Polyvinyl chloride. |
| RAS | Recirculating aquaculture system |
| RLD | Root length density. |
| R_m | Repair and maintenance costs. |
| RMSE | Root means square error. |
| SGR | The specific growth rate. |
| TAN | Total ammonia nitrogen. |
| Tc | Total costs. |

| | |
|---|--|
| UVI | University of the Virgin Islands. |
| Vc | Variable costs. |
| WG | The fish mass gained. |
| WUS | Water use efficiency. |
| ΔDW_{root} | The daily amount of root dry mass increment. |