EFFECT OF WATER SALINITY ON HYDROPONICS PLANT GROWTH

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INTRODUCTION

Hydroponics comes from the Greek words “hydro”, which means “water “and “ponos” which means “work”.

In 1929, hydroponics was popularized by Gericke during World War II.

In the 1960s, Allen Cooper from England came up with the Nutrient Film Technique (NFT).

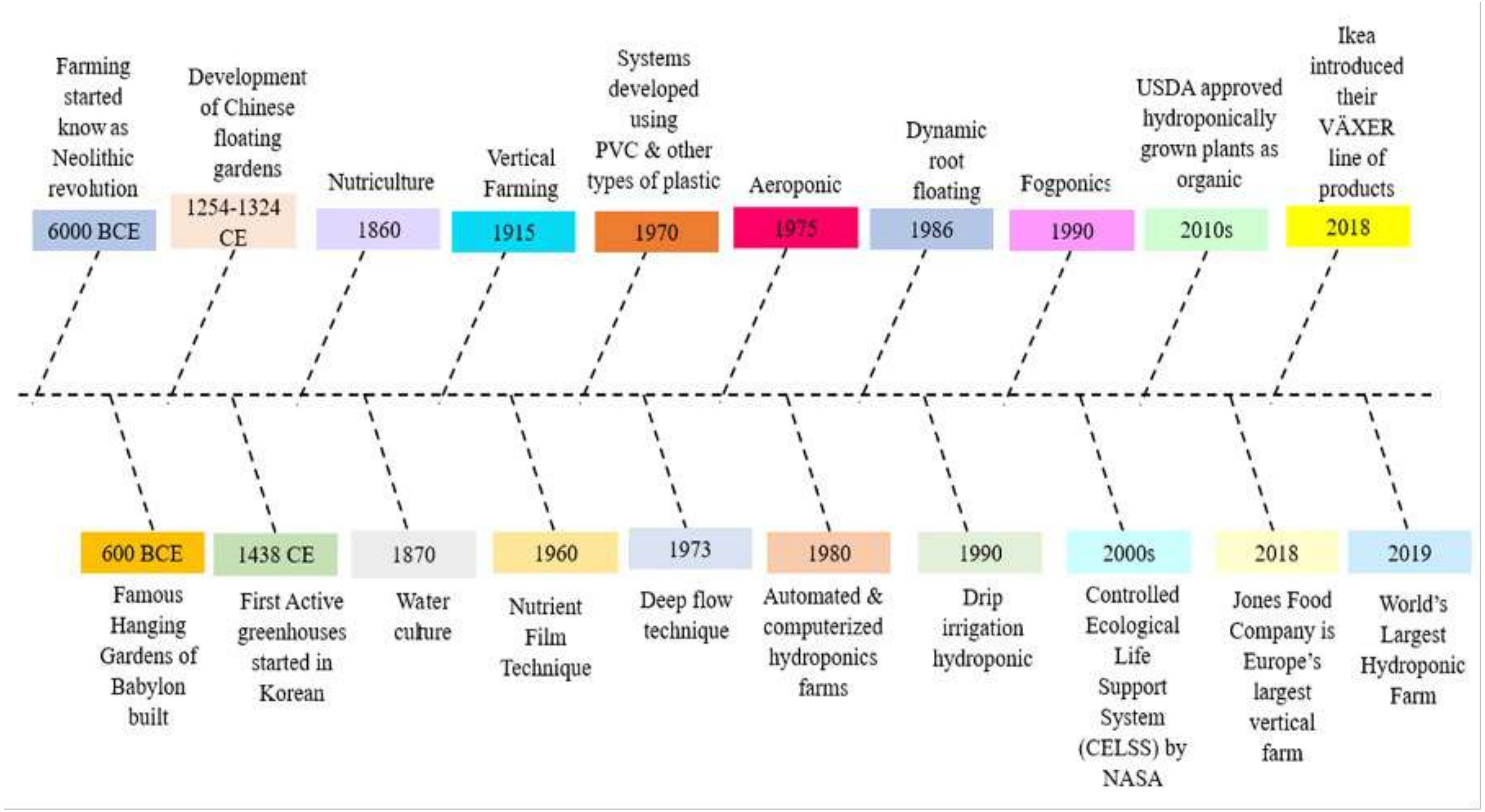

Figure 1.1: Historical Aspect of The Techniques

Advantages And Disadvantages of hydroponics

Advantages

- Can be used in places where agriculture or gardening on the ground is not feasible.
- Improved nutrition and environmental management.
- No risk of soil-borne disease, bug or pest infection to the crops.
- Plants require less time to grow.

Disadvantages

- Commercial production requires specialist knowledge and a larger investments.
- plants share the same nutrient, and water-borne diseases can quickly move from one plant to the next.
- High temperatures and low oxygenation diminish crop yields and cause crop loss.

Types Of Hydroponics Systems

There are two main types of hydroponic systems: (Jayachandran *et al.*, 2022) :

- Open system
- Closed system

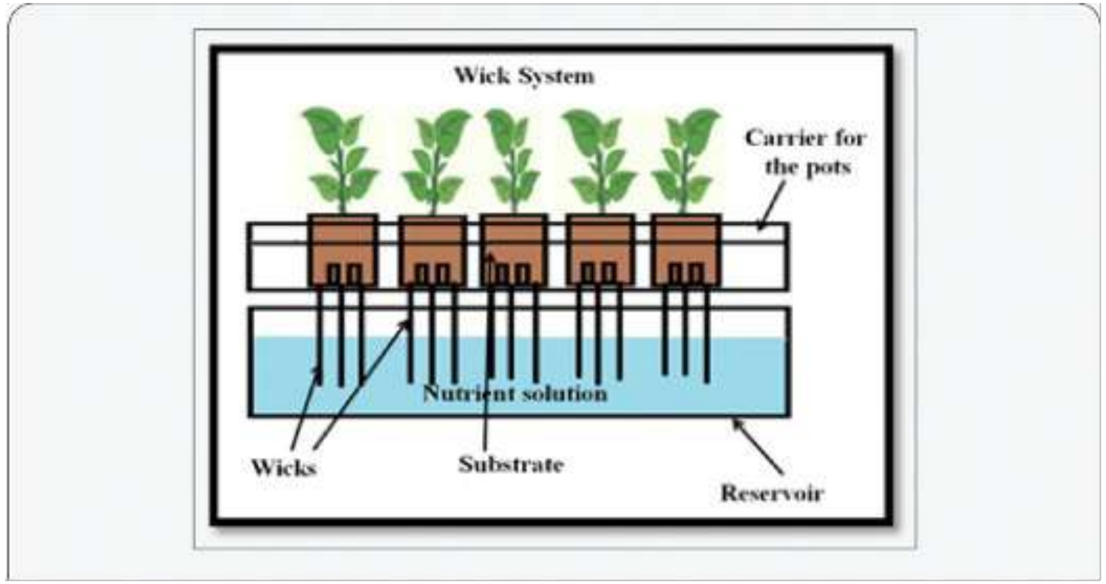

Figure 1.1: Wick System Set

- The plant system absorbs the nutrients through the capillary action of the roots and fibers that carry water to the plants.
- It is cost-effective as it does not require the use of external energy.

Types Of Hydroponics Systems

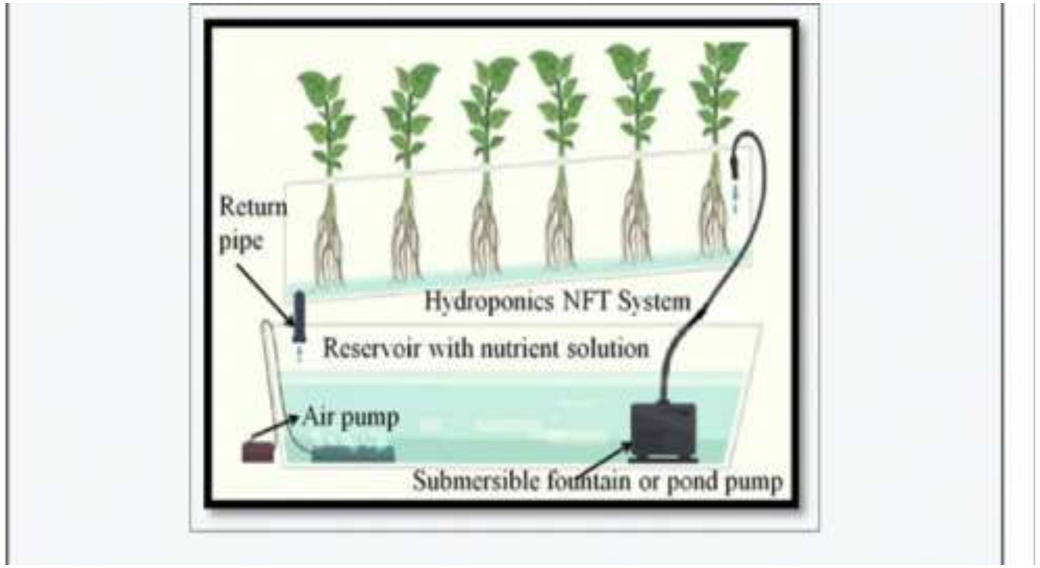

Figure 1.2: Nutrient Film Technique Set Up

- The plants obtain the necessary nutrients and oxygen through their roots from the thin film of nutrient solution.

- Plants are grown on rafts, panels, or boards that float or are hung in a container with a nutrient solution that is about 10 to 20 cm deep.
- The roots of the plants are kept in the nutrient solution with just the right amount of airflow.(El-Kazzaz, 2017)

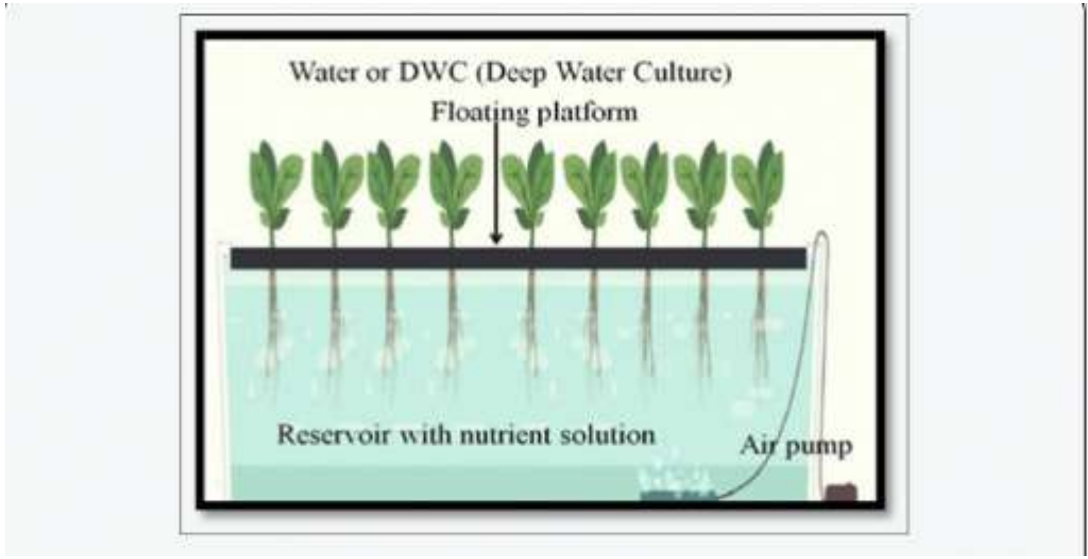

Figure 1.3: Deep Water Treatment Set Up

Types Of Hydroponics Systems

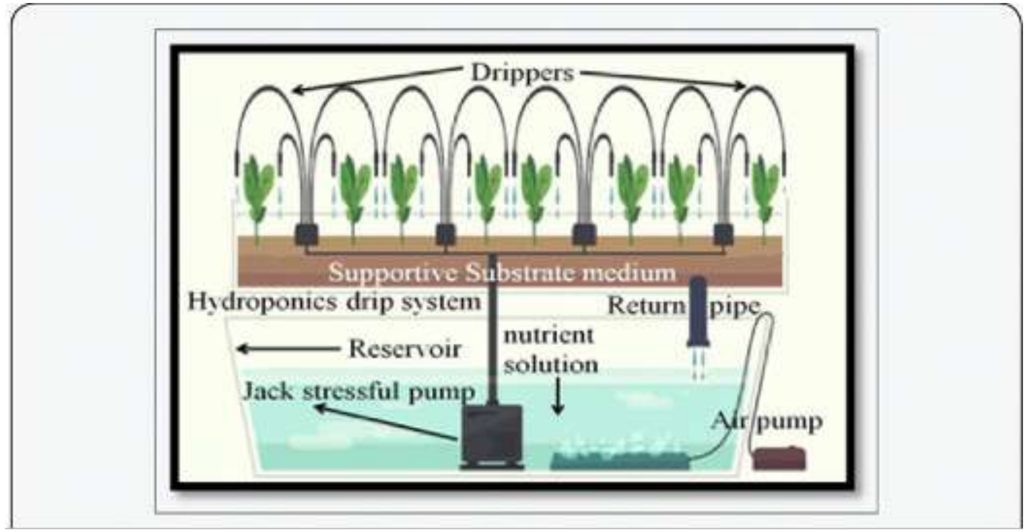

Figure 1.4: Drip Hydroponic System Set Up

- The plants are in the top container and the nutrient solutions are in the bottom container.
- A pumping device is used to bring the oxygenated nutrient solution up to drips close to the root.
- The bubbling of the nutrient solution makes the water more oxygenated. (El-Kazzaz, 2017)

- Similar to the drip hydroponic system.
- Instead of pumping the nutrients to the roots of the plants through drippers, this hydroponic system sends a flood of them straight to the roots.

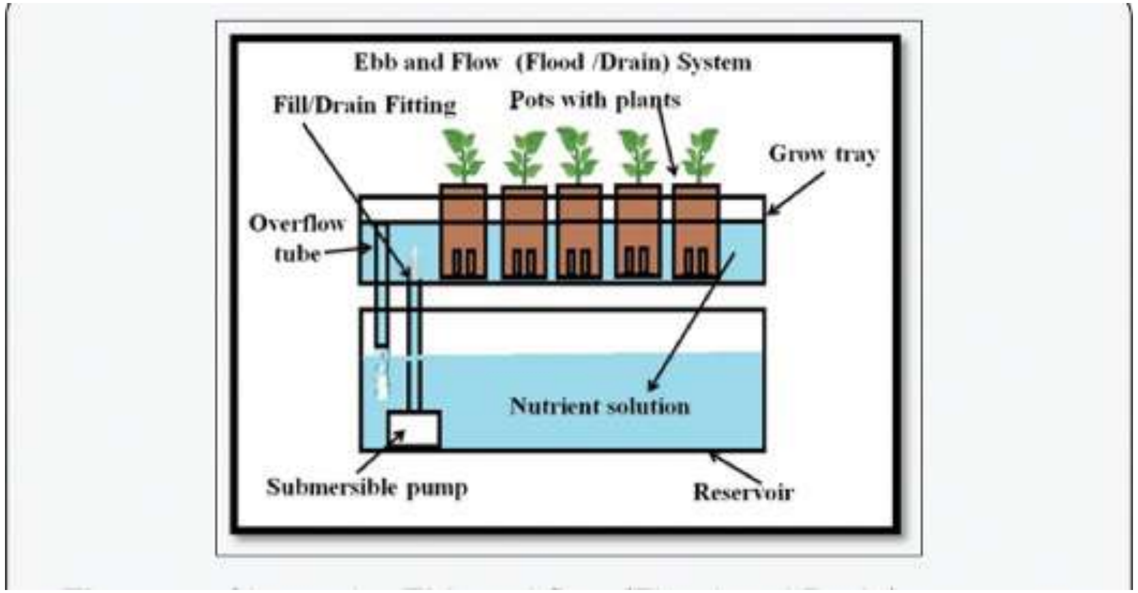

Figure 1.5: Ebb and Flow System Set Up

Types Of Hydroponics Systems

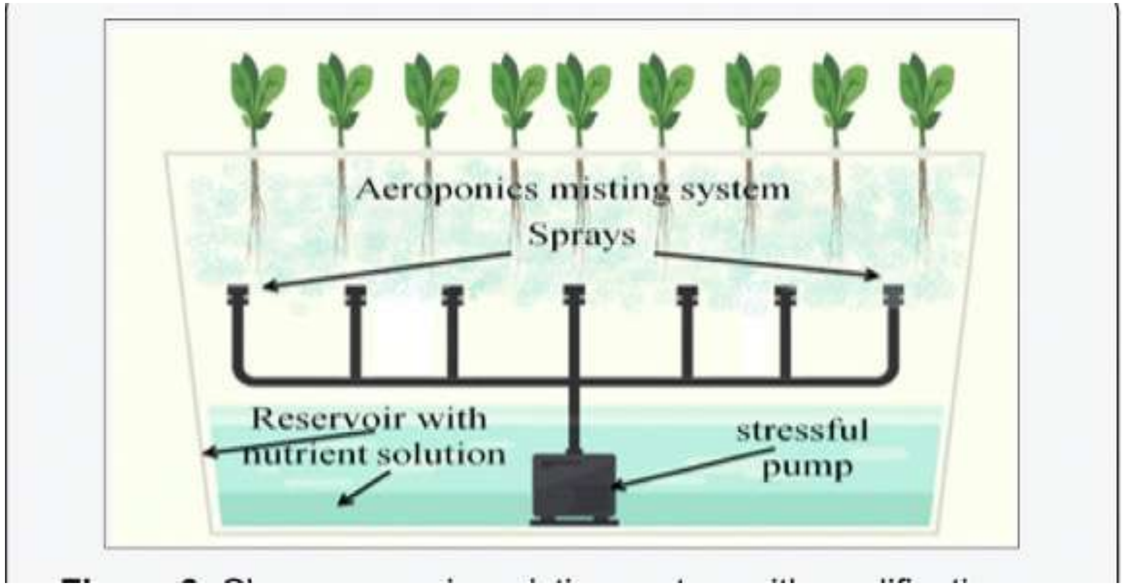

Figure 1.6: Aeroponics System Set Up

- Most advanced hydroponic system on the market.
- The plants are placed horizontally at the top of the growing container and are held up by plastic or polystyrene panels to hold up the root system.
- Is not widely used because it requires a lot of money to set up and run.
- It works best for small horticultural crops. (EI-Kazzaz, 2017)

Parameters Affecting Hydroponics

- Temperature
- PH And Electrical Conductivity
- Light
- Air
- Water

Problem Statement

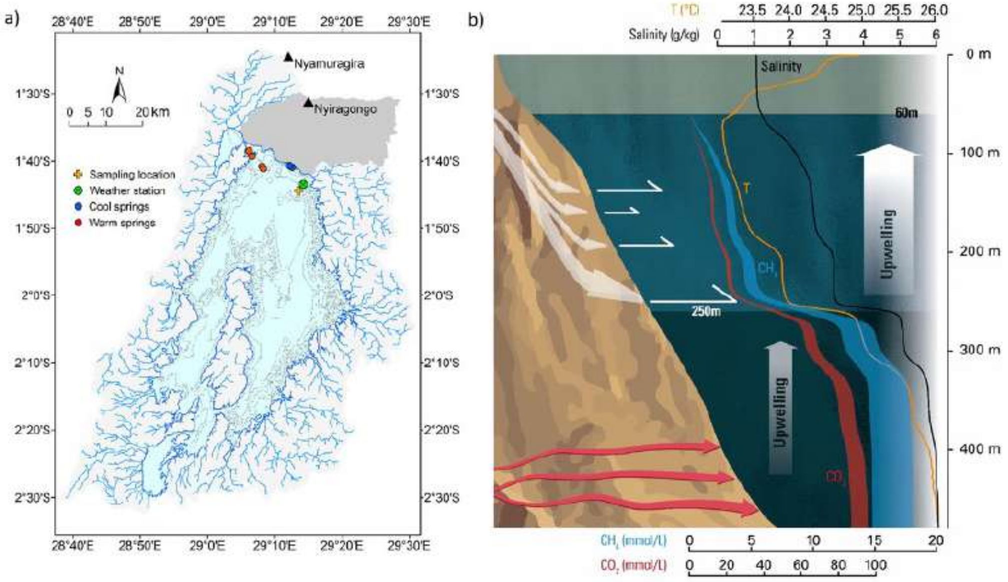

Figure 1.3.: A Map Of Lake Kivu With Bathymetry (Bärenbold, Kipfer and Schmid, 2022)

Figure1.4.: Image of Lake Kivu from (Encyclopaedia Britannica, 2020)

The goal is to assist in solving the problem DR Congo has been experiencing. **By identifying the effect of water salinity (salt concentration) on hydroponics plants,** we can introduce hydroponic farming to the Democratic Republic of the Congo and give the country access to the many benefits of hydroponics for national development.

Aims And Objectives

- To evaluate the effect of salt **on physical plant growth parameters** such as root length, shoot length, plant weight, fresh weight and dry weight, color, and shape, based on **different Na+ concentrations**.
- To determine the rate of **growth of the plants** including leaf width, leaf number, leaf height, and leaf diameter, based on **different Na^{+} concentrations.**

Scope Of Study

- This project will use **deep-water culture** to study how hydroponically grown plants respond to salt stress.
- The experiment will involve five salinity concentrations: **1000 mg/l (control), 2500 mg/l, 5000 mg/l, 7500 mg/l, and 10000 mg/l.**

LITERATURE REVIEW

Salinity

- Salinity is defined as the salt concentration in water or soil.

Table 2.1: The Salinity Classifications, By Total Salt Concentration

Salinity Status	Salinity (Milligrams of Salt Per Litre)	Description And Use
Fresh	< 500	Drinking and all irrigation
Marginal	500 – 1 000	Most irrigation, adverse effects on ecosystems become apparent.
Brackish	1 000 – 2 000	Irrigation certain crops only; useful for most stock
Saline	2 000 – 10 000	Useful for most livestock
Highly Saline	10 000 – 35 000	Very saline groundwater, limited use for certain livestock.
Brine	>35 000	Seawater; some mining and industrial uses exist.

Salinity

In this study ,salinity levels of two countries has been compared: DR Congo and Bangladesh.

Salinity concentration in Bangladesh (mg/l)	Salinity concentration in DR Congo (mg/l)
	1000 (Control)
2500	
5000	
7500	
10000	

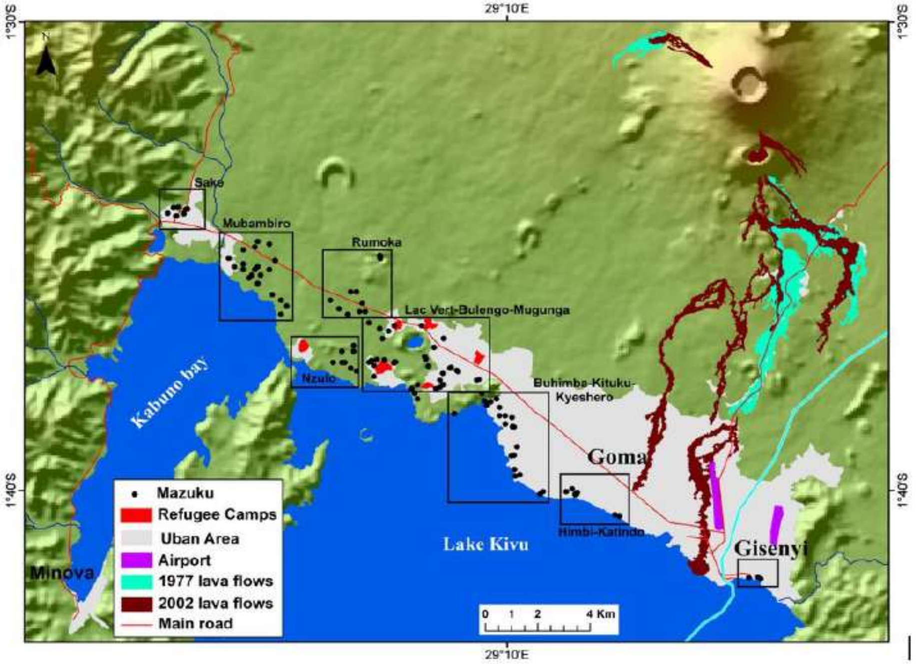

Figure 2.1: Map of The Goma Area with Nyiragongo Volcano, Lake Kivu.

Effect Of Salinity on Plant Growth

According to the research papers that were looked at, salt stress had a big effect on morphological, physiological, and biochemical properties of plant growth.

Physical Properties	Chemical Properties
• Both the root and shoot lengths exhibited a decrease in growth. • Increasing salt concentrations also had a substantial impact on the total plant mass and average leaf number of the plant. • Root and shoot length are significantly impacted by salt stress. • Change in fresh and dry weight.	• Proline, protein, and reducing sugar accumulation increased significantly, • Reduction in chlorophyll content with an increased of salinity.

Physical Properties and Rate Of Plant Growth with Respect Of Varying Salinity

Figure 4.1: The Reduction in Growth with Increased of Salt Salinity (Sium Ahmed, 2019)

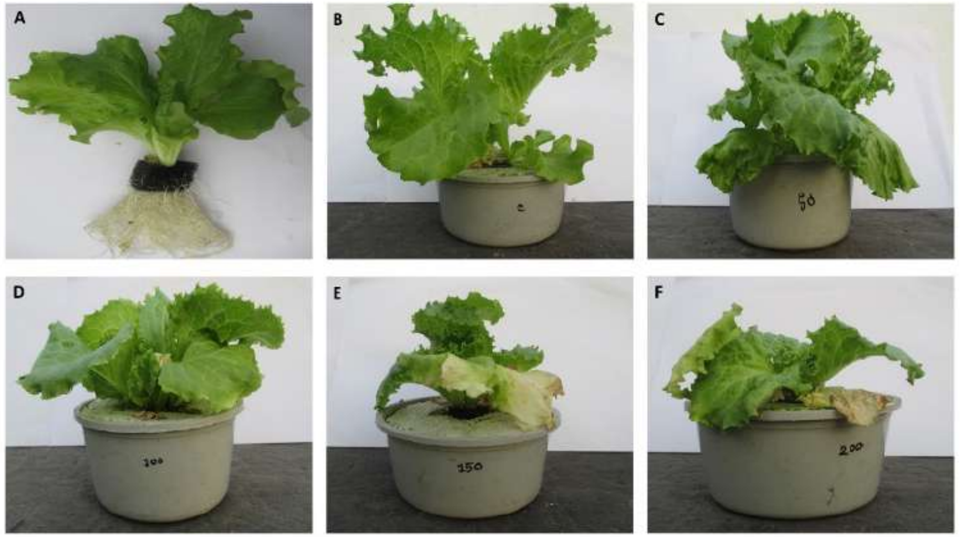

Figure 4.2: (A) Before Salt Treatment (B) Control (0 Mm) (C) 50 Mm (D) 100 Mm (E) 150 Mm (F) 200 Mm (Sium Ahmed, 2019)

Table 4.1: Effect of Salt Treatment on The Shoot, Root Length, Weight And Leaf Number Of Lettuce Plants Investigated Three Consecutive Weeks After Mitigation Of Salt Stress.(Sium Ahmed, 2019)

Salt Concentration	Time	Shoot Length (cm)	Root Length (cm)	Total Plant Weight (g)	Number of leaf
Control (0mM)	First week Second week Third week	15 ± 0.41a 16.75 ± 0.63a 17.5 ± 0.20a	15±1.08a 16.25±0.25a 16.5±0.28a	51.46±2.26a 59.13±2.56a 62.75±0.85a	12±0.63a 17±0.71a 17±0.41a
50 mM	First week Second week Third week	13.25±0.63ab 14±0.41b 16.7±0.18a	14.75±0.25a 14.50±0.29ab 15.4±0.23a	41.15±2.25b 55.12±2.21a 53.65±0.39b	11±0.48a 14±0.70b 14±0.19b
100 mM	First week Second week Third week	11.25±0.48bc 11.50±0.29c 11±0.35b	14.50±0.28a 13.25±0.48bc 13±0.58b	35.59±0.90bc 30.24±1.74b 13.55±0.21c	10±0.29ab 11±0.48bc 10±0.26c
150 mM	First week Second week Third week	10.75±0.75c 11±0.71c 10.5±0.17b	11.50±0.29b 11.75±0.63c 11.4±0.20c	28.46±1.45cd 24.88±0.97b 7.1±0.13d	8±0.87bc 8±0.65cd 7±0.28d
200 mM	First week Second week Third week	9+0.00c 7.88 ± 0.13d 6.8 ± o.21c	11±0.58b 9.5±0.29d 9.5 ± 0.26d	24.60±1.17d 15.62±1.16c 6.95±0.22d	6±0.85ce 6±0.75d 6±0.32d

SAVE MORE ENERGY

Importance of hydroponics on energy saving

SAVE MORE ENERGY

Implementing hydroponics culture in DR Congo can potentially help save more energy in several ways:

1. Reduced water usage: By reducing the amount of water needed for crop production, hydroponics can help conserve water resources and save energy that would otherwise be required to transport and treat water.

2. Reduced transportation costs: This can save energy and reduce greenhouse gas emissions associated with transportation.

3. Reduce land use:. By using hydroponics, crops can be grown in smaller areas, making more efficient use of land resources. This can help conserve natural habitats and reduce the environmental impact of agriculture, ultimately saving energy.

4. Controlled lighting :LEDs use up to 80% less energy than traditional lighting, resulting in significant energy savings.

5. Reduced use of chemical inputs :. This can save energy that would otherwise be required to manufacture, transport, and apply these chemicals.

6. Controlled environment:. Hydroponics allows growers to create a controlled environment, which can optimize crop growth and reduce the need for energy-intensive heating, cooling, and pest control measures.

Thank You!