Soilless Fresh Produce Hydroponics for Low-income/Low-food Access Navajo Communities: An Alternative to Cropping Uranium Contaminated Soil

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NTU HYDROPONIC PROJECT

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SIGNIFICANCE OF THE PROBLEM

The focal region of this proposal is classified by the USDA-Economic Research Service (2020) as a low income-limited access to grocery stores, ‘Food Desert’.

There are major constraints and challenges in McKinley County, NM limiting the growth and productivity of agronomically-important grain and vegetable crops

These constraints include, but are not limited to, soil contamination with uranium, heavy metals, poor soil health, lack of high-quality agricultural water, and drought. Uranium spills and abandoned mines across the landscape along with low annual rainfall limits the growth of fresh fruits and vegetables in soil-based cropping systems in this Navajo Nation region.

OBJECTIVES

- **Objective 1: Evaluate Hydroponic (HP) Systems for Production of Fresh, Nutritious Produce at Navajo Technical University**
- Aim 1.1: *Establish/ Operate Systems to Conduct HP Research at NTU*
- Aim 1.2: *Conduct Hydroponic Research at NTU, SFCC, UMES, and ARS*
- Aim 1.3 *Draft/Review Best Practices for NTU and Hydroponics in Neighboring Communities*
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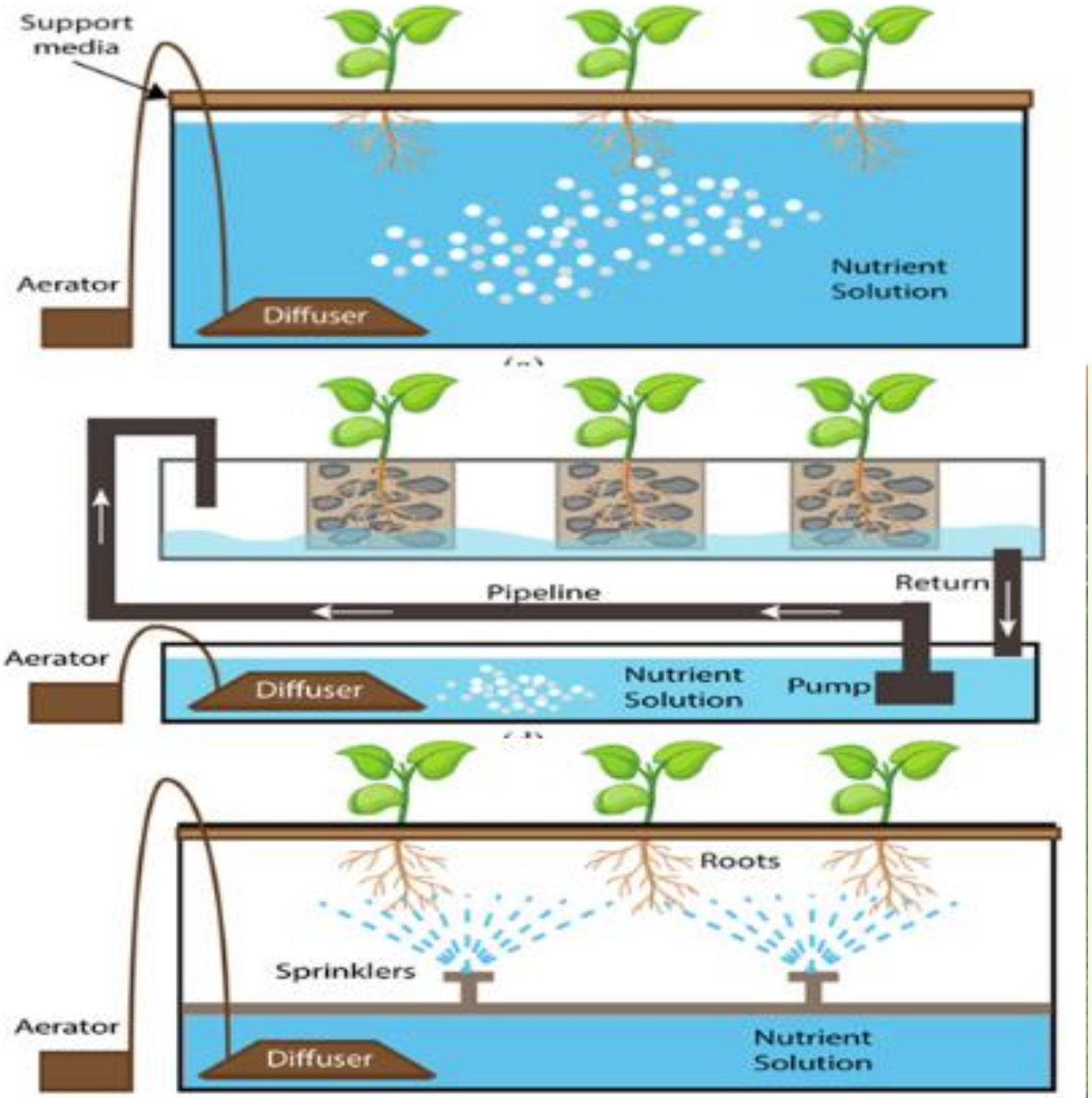
OBJECTIVES

- **Objective 2: Implementation of Best Practices for Soilless Production using Hydroponics in a New Mexico Climate**
- Aim 2.1: *Train Navajo Community Members on Set-up and Management of Hydroponic Systems*
- Aim 2.2: *Evaluate plant production performance and the phytonutrient content of hydroponic fresh produce harvested from NTU and MLCH compared to equivalent store-bought commodities.*
- Aim 2.3 *Outreach, publications;*



1) Deep water culture (DWC) hydroponic systems (**Fig. #a**), where plants in rafts or net pots float on ponds of recirculating nutrient solution, submerging the roots. A similar but non-recirculating system (Kratky method) can also be used without the use of an aeration pump.
2) Nutrient-film technique (NFT) hydroponic systems (**Fig. #b**), where nutrient solution is recirculated over plant roots in shallow gutter-style channels (Velazquez-Gonzalez et al., 2022); 3) Aeroponic production (AeroP) systems (**Fig. #c**), in which water and nutrients are periodically sprayed onto roots suspended in air.

Dutch Bucket
(Bato Bucket)

WHY HYDROPONICS

Hydro compared to soil production

- Reduced Fertilizer and Water Use
- Increased Production
- Conservation of Land and Soil
- Reduced Labor
- More Appropriate for MonoCrop
- Safe from Contaminated Soil

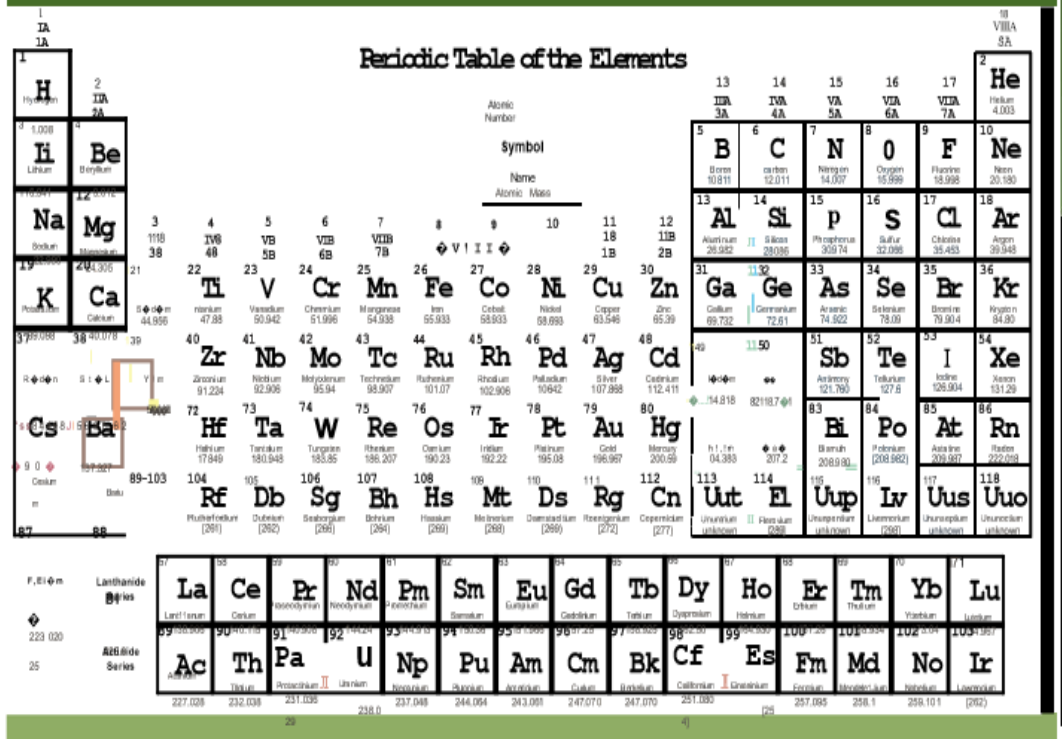
Hydro compared to soil production

- Soil Fertility Hard to Manage Over Time
- Hydroponics Delivers Water Soluble Nutrients, Tailored
- Little to No Nutrient Loss
- Monitored and Controlled for Each Stage of Plant Growth
- Precise Water Delivery
- Improves Productivity and Enhances Quality of Produce

Hydro compared to soil production

- Less Labor for Tilling, Plowing, Mulching, Weeding
- Easier to Harvest and Clean Produce
- No Tired Soils with Low Fertility and Pest Populations
- More Expensive Upfront
- Needs Reliable Electricity
- More Complex than Soil
- Daily Management of Complex Skill Sets

Periodic Table of the Elements



PERIODIC TABLE OF PLANT NUTRIENTS

7 14 N Nitrogen	15 31 P Phosphorus	19 39.1 K Potassium	12 24.3 Mg Magnesium	16 32.1 S Sulfur	20 40.1 Ca Calcium	1 1 H Hydrogen	6 12 C Carbon	8 16 O Oxygen
Mobile	Mobile	Mobile	Mobile	Variable Mobile	Immobile			

MACRONUTRIENTS

5 10.8 B Boron	17 35.5 Cl Chlorine	25 54.9 Mn Manganese	26 55.8 Fe Iron	29 63.5 Cu Copper	30 65.4 Zn Zinc	42 95.9 Mo Molybdenum
Immobile	Mobile	Immobile	Immobile	Variable Mobile	Variable Mobile	Variable Mobile

MICRONUTRI ENTS

L	M Music	27 58.9 Co Cobalt	34 79 Se Selenium	13 27 Al Aluminum	28 58.7 Ni Nickel	14 28.1 Si Silicon	11 23.0 Na Sodium

BENEFICIAL NUTRIENTS

NTU HYDROPONIC SYSTEM


BIOLOGY PROGRAM


SFCC
SANTA FE COMMUNITY COLLEGE
INTRODUCTION TO HYDROPONIC & AQUAPONIC FOOD PRODUCTION
USDA
NIFA
United States Department of Agriculture
National Institute of Food and Agriculture
Project Funded by
PRESENTER:
R. Charlie Shultz

IMPACT OF THE PROJECT

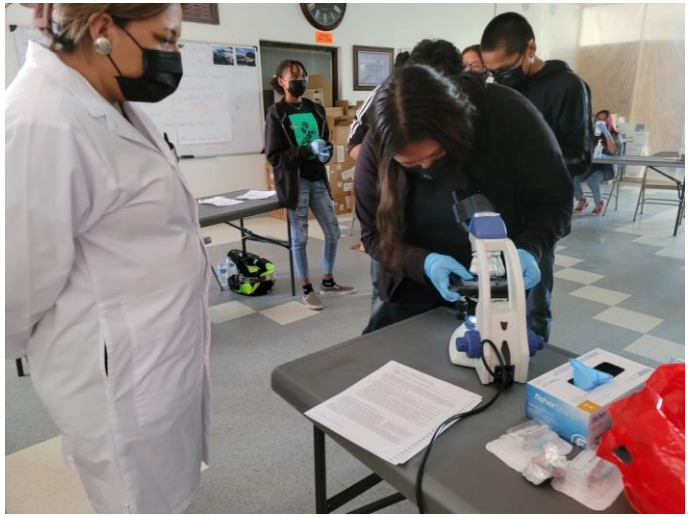
- Training and Workshops
- Community Projects Recruitment
- Production
- Research
- Created jobs

RECRUITING FROM HIGH SCHOOLS

MARIANO LAKE CHAPTER HOUS
HIGH TUNNEL


MARIANO LAKE
CHAPTER

- Crownpoint Chapter House.
- Mariano Lake Chapter House.
- Biology Lab Activities.
- High Schools




Travel 5210
Registration 5329
License + Fees 5670
PDP 5131
Hydroponic Farming
Advantages of Hydroponics
Faster plant growth
Uses up to 90% less water
No weeding
Can be done indoors, vertically, or in urban spaces
No soil-borne diseases
Common crops grown hydroponically (Lettuce Spinach Basil Kale Tomatoes Strawberries Peppers Cucumbers)
SFCC Hydroponic Farm
SFCC Hydroponic Farm (tomato plant)
36

On Going Research Projects

- Isolation and Molecular identification of extremophiles from Uranium contaminated trailing mines on the Navajo Nation.
- Molecular Identification of antimicrobial metabolites in endophytic fungi in desert plants.
- Analyzing the development of antimicrobial resistance of Desert microbes influenced by uranium contamination.
- Novel Soil Antibiotic against selected bacteria
- Novel anti-cancer properties in desert plants.
- Documenting vouchers of Ethnobontany plants.

THANKS FOR YOUR ATTENTION.