U.S. DEPARTMENT OF ENERGY
AlgaePrize
NextGen Algal Innovators

Team Name:

The Clean Water Cultivators

Team Schools/Organizations:

Santa Fe Community College, Santa Fe, NM

Abstract:

With an estimated 238,000 working farms and ranches in the United States, the largest source of nonpoint source (NPS) pollution to our water supplies is from agricultural runoff. In the 2000 National Water Quality Inventory, Agricultural NPS pollution was found to be the largest source of impact to water quality in surface waters, the second largest source of NPS pollution of wetlands and a major contributor to pollution of estuaries and groundwater supplies. This runoff carries nutrients feeding eutrophication cycles in surface waters and contaminates that can make their way into ground water supplies. While these nutrients are the root of this ecological problem, they also represent a substantial percentage of the global energy consumption; the Haber Bosch process alone represents around 1% of the total world energy consumption and consumes 5% of the natural gas produced globally each year. Additionally, many of the nutrients needed for crop production are increasingly hard to access, dwindling supplies increase the need for conservation while mining, processing, packaging, and shipping of these fertilizers represent energy intensive processes. Resulting algal blooms from agricultural NPS pollution affect recreation and drinking water quality and kill fish by removing oxygen from the water as a result of algal decomposition. Further elevated nitrate levels in drinking water supplies leads to methemoglobinemia or blue baby syndrome. The resulting cost, both financially and in energy, of cleaning up blooms, dead fish, water treatment to address the taste, odors, color, and nitrate problems in these surface water supplies compound the cost of this runoff.

Increasing demands on the water supply, prolonged drought in many regions, and changes in precipitation due to climate change paired with the need to produce more food--a projected 50% increase by 2050—will cause greenhouse crop production, with its potential for water and energy savings, to continue to be a growing sector in farming. While there are several system designs with varying water costs, many hydroponic

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farmers chose drain-to-waste systems over recirculating options. This is due to bio security concerns and the high cost and energy consumption of treatment technologies. We feel that there is an opportunity to utilize the rapid growth of algae to process agricultural wastewater to EPA effluent discharge to surface water standards while harvesting a viable soil amendment, reclaiming nutrients otherwise lost to runoff. We plan to design and build a photobioreactor to capture and process wastewater from a small hydroponic tomato farm in northern New Mexico. The farm currently consumes around three acre-feet of water annually for crop production, facility cleaning and one family residence. The entire property is serviced by a reverse osmosis (RO) system with a production ratio of one gallon RO water to two gallons of waste. Our system will capture the waste nutrient solution and RO wastewater and process it through the reactor. We will utilize an organic matrix to house natural microbial assemblage growth. It is our goal to choose a matrix that can be harvested from the reactor, desiccated, and applied to the soil with no other processing, ensuring minimal energy consumption.