CAL POLY POMONA

LYLE CENTER for Regenerative Studies

A Display of Water Efficient Agriculture Practice in Three Valleys Municipal Water District

Local project

Faculty Project Manager: Maryam Shafahi

Student Project Manager: Jordan Jarnagin

Mechanical Engineering Department
California State Polytechnic University, Pomona

ONE-PAGE SUMMARY

The proposed project will be on setting up an aquaponics in Three Valleys Municipal Water District showcasing a water efficient, environmentally friendly food production system. The design, manufacturing and maintenance of the system will be performed by Cal Poly Pomona students. It would be a collaborative research project between Cal Poly and Municipal Water District while being a public display of wave of the future for our troubled water-food-energy triangle. The annual efficiency of the system in terms of water consumption, crop yield and fish growth will be studied.

CONTACT INFORMATION

College	College of Engineering, California State Polytechnic, Pomona
Department	Mechanical Engineering
Make Check Payable To:	Cal Poly Foundation, Inc, 3801 West Temple Avenue Pomona, CA 91768

A.

Application Strand	Select One
LOCAL Project Name	A Display of Water Efficient Agriculture Practice in Three Valleys Water District
GLOBAL Project Name	

B.

Faculty Project Manager	Maryam Shafahi	
Title	Assistant Professor	
Department	Mechanical Engineering	
Campus Address	3801 W Temple Ave, Pomona, CA 91768	
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C.

Student Project Manager	Jordan Jarnagin	
Undergraduate or Graduate	Undergraduate	
Department	Mechanical Engineering	
Cell Phone / Email Address	9099570148	Jtjarnagin@cpp.edu

D.

Contracts Manager / Officer	Dr. Frank Ewers	
Title	Associate Vice President for Research	
Department	Office of research	
Campus Address	3801 West Temple Avenue Pomona, CA 91768	
Telephone / Email Address	909 869 – 4132	fwewers@cpp.edu

PROJECT MANAGEMENT TEAM

	NAME	TITLE / ORGANIZATION	ADDRESS	PHONE & EMAIL
1	Maryam Shafahi	Assistant Professor/ Cal Poly Pomona	Mechanical Engineering, Cal Poly, Pomona	9098693201 mshafahi@cpp.edu
2	Kevin Anderson	Professor/ Cal Poly Pomona	Mechanical Engineering Department, Cal Poly, Pomona	kranderson1@cpp.edu
3	Aaron Fox	Assistant Professor/ Cal Poly Pomona	Plant science department, Cal Poly, Pomona	affox@cpp.edu
4	Reza Baghaei	Assistant Professor/ Cal Poly Pomona	Engineering Technology Department, , Cal Poly, Pomona	rblakeh@cpp.edu
4	Jordan Jarnagin	Student/ Cal Poly Pomona	Mechanical Engineering Department, Cal Poly, Pomona	Jtjarnagin@cpp.edu
5	Aaron Thormodsen	Student/ Cal Poly Pomona	Mechanical Engineering Department, Cal Poly, Pomona	aathormodsen@cpp.edu
6	Brian Lace	Student/ Cal Poly Pomona	Mechanical Engineering Department, Cal Poly, Pomona	btlace@cpp.edu

MEMBER AGENCY(IES) / LOCAL WATER AGENCY(IES)

	NAME	TITLE / ORGANIZATION	ADDRESS	PHONE & EMAIL
1	*Cindy DeChaine*	*Three Valleys Municipal Water District*		cdechaine@TVMWD.com *(909) 621-5568*
2				
3				

ORGANIZATIONAL BACKGROUND

Cal Poly Pomona opened September 15, 1938 with an all-male enrollment of 110 students as the Voorhis Unit of California State Polytechnic College in San Luis Obispo. It was located on the 150-acre San Dimas site of the former Voorhis School for Boys.Breakfast cereal magnate W.K. Kellogg deeded 813 acres of land located three miles south of the Voorhis campus to the state of California in 1949.

In 1956, 508 students and 44 faculty and staff moved from San Dimas to the Kellogg campus. In a first for the all-male campus, 329 women joined the student body in 1961. The Pomona campus separated from the San Luis Obispo campus in 1966 and became California State Polytechnic College, Kellogg Campus. University status was granted in 1972.

Today, the campus covers 1,438 acres and is the second largest in area among the California State University's 23 campuses. About 2,700 faculty and staff support the education of 22,000 students.

Mission

Cal Poly Pomona's mission is to advance learning and knowledge by linking theory and practice in all disciplines, preparing students for lifelong learning, leadership and careers in a changing multicultural world.

The Vision of Cal Poly Pomona

California State Polytechnic University Pomona will be recognized as a national leader in polytechnic education, where hands-on learning is the foundation of a broad-based educational experience. Our graduates will be distinguished by their understanding of theory, the ability to think critically and the capacity to apply that knowledge in a real-world setting. Cal Poly Pomona will embrace change, through teaching, learning, and scholarship that continually addresses the needs of a diverse culture and a dynamic economy. Cal Poly Pomona will be a model of a learning-centered university in all aspects of campus life. The mission of the university will be rooted in our core values:

Core Values

- **Polytechnic Identity:** We take great pride in our polytechnic identity, realizing our exclusive role in higher education. Cal Poly Pomona is responsible to its constituents by providing quality instruction in the unique programs that distinguish the university.
- **Academic Quality:** We are committed to academic rigor and excellence in our teaching, learning, and scholarship. A Cal Poly Pomona education transforms prepared students into successful alumni.

- **Learn By Doing:** We are distinguished by our active, hands-on approach to learning, both in and out of the classroom.
- **Teacher-Scholars:** We are committed to producing and supporting faculty teacher-scholars. Developing state-of-the-art facilities will allow faculty to collaborate with students so as to generate knowledge and develop real-world solutions.
- **Environmental Sustainability:** We recognize our responsibilities to the global community and value the importance of applying and advancing sustainable practices in the classroom and on our campus.
- **Celebration of Diversity:** Cal Poly Pomona embraces diversity as a core value, ensuring that the campus community reflects the state and region it serves.

Aquaponics in Cal Poly Pomona

The aquaponics project started in spring 2012 involving two Mechanical Engineering students working with Dr. Shafahi. This project has been funded by multiple internal and external grants serving 57 students from different backgrounds as their senior project, special study, and course project. Currently, there are one semi-commercial and 10 small prototype aquaponics systems in Cal Poly Pomona. This project will be the subject of a service learning course during spring 2016 serving k12 students in Pomona district.

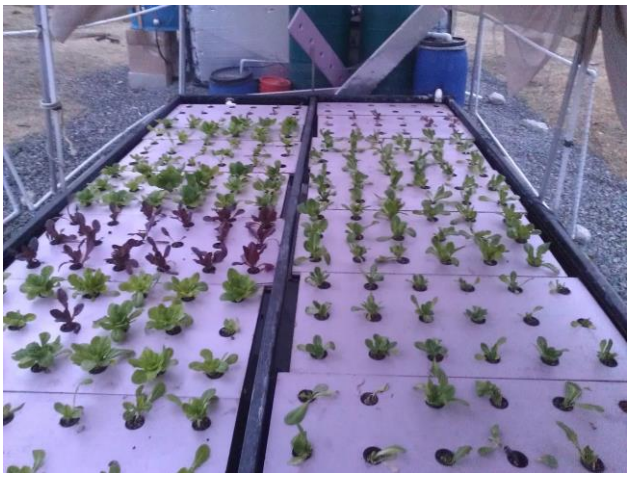

Figure 1 - Aquaponics facility in Cal Poly Pomona

CERTIFICATE OF ATTENDANCE

PROJECT DESCRIPTION

Which water-related issue or challenge have you selected? Drought and polluted environment

Is it a local or global focus per the RFP guidelines? Local

Which content strand (technology, policy or communications) have you chosen as the research focus for creating your project? Technology and communication

Where will the research and data collection take place? Three Valleys Municipal Water District

The proposed project will be on an aquaponics setup in Three Valleys Municipal Water District showcasing a water efficient, environmentally friendly food production system. The design, manufacturing and maintenance of the system will be performed by Cal Poly Pomona students. It would be a collaborative research project between Cal Poly and Municipal Water District while being a public display of wave of the future for our troubled water-food-energy triangle. The annual efficiency of the system in terms of water consumption, crop yield and fish growth will be studied.

Water crisis effects and environmental protection

Aquaponics, an increasingly popular farming system, produces fish and crops with noticeably less amount of water used in traditional farming [1]. We are running out of fresh water and adopting water efficient agriculture systems is extremely valuable considering current global and local drought. Additionally, crop production represents the largest source of groundwater nitrate in the majority of agricultural lands in California which has been raising public health concerns [2]. Aquaponics is a closed loop system with no nitrogen leakage to the environment. It provides faster growth rate and better quality of the crops. Moreover, aquaponics is able to grow crops in places where ordinary horticulture and aquaculture is impossible due to poor or contaminated soil or water. Another beneficial factor is minimizing the growing area [3-5].

Renewable energy utilization

The power required for pumping and maintaining the appropriate water temperature for the fish will be provided by solar energy. The system is using renewable energy and has the capability to run off-the-grid in the remote areas where there is little access to electricity. Food production systems utilizing renewable non fossil fuel energy are the long term solution to our troubled world struggling with the tightening energy bottleneck.

What is the anticipated outcome of your research? An outcome may be short-term (i.e., changes in knowledge or attitude) or long-term (i.e., changes in condition of natural resources).

Aquaponics can be the potential solution for many problems agriculture industry is facing in California and throughout the globe. Agriculture is a major user of ground and surface water in the United States, accounting for approximately 80 percent of the Nation's consumptive water use and over 90 percent in many Western States[8]. Adopting water efficient agriculture systems can make a significant difference in water consumption scenario. There is little scientific data on aquaponics water consumption. Hence, the results of this research will be extremely valuable to Agriculture and Food industries. The water efficiency of this system will be compared with the typical farming practices by crop yield measurement.

Three Valleys Municipal Water District is a perfect location for showcasing a water efficient, environmentally friendly agriculture system since it serves a number of cities, areas and water districts in eastern Los Angeles County. Aquaponics needs to be introduced to the water industry. This project will modernize and validate the concept of aquaponics to be introduced to the entrepreneurial, industrial and educational institutes. At the same time, students participating in the project either as coursework or research will be each an advocate of change, growing healthy food in their homes and communities

Describe your team's experience and technical capabilities (including in-house and/or outside hired individuals) to accomplish the project. List the roles and responsibilities of each team member.

Project team
Dr. Maryam Shafahi: Assistant Professor, Mechanical Engineering,
Dr. Kevin Anderson: Professor, Mechanical Engineering,
Dr. Reza Baghaei Lakeh: Assistant Professor, Engineering Technology,
Dr. Aaron Fox: Assistant Professor, Urban and Community Agriculture,
Jordan Jarnagin: Undergraduate student, Mechanical Engineering
Aaron Thormodsen: Undergraduate student, Mechanical Engineering
Brian Lace: Undergraduate student, Mechanical Engineering

Dr. Shafahi has been working on the aquaponics project since 2012. Her group has presented the results of this research in several national and international conferences, published in peer review journals and obtained multiple internal and external funding to develop and maintain the research. She will be the main PI, responsible for finishing project research, project management, and project outreach including the timely completion ofproject activities and direct liaison with partners. Dr. Anderson and Baghaei will help with the solar energy utilization and Dr. Fox will contribute in crop yield measurements and plant science aspects of the research. Jordan Jarnagin is the student project manager who has been actively working on this project for about a year. Aaron Thormodsen and Brian Lace will be working on the gray water filtration aspect as their senior project.

Provide a project schedule with key milestone dates and deliverables with measurable outcomes.

Winter 2016	Literature survey
Spring 2016	Design of the solar powered aquaponics
Summer 2016	Manufacturing and data collection
Summer 2016 - Fall 2016	Maintenance and data collection
Winter / 2017	Colleges schedule and conduct a “dry run” of project presentation
Spring 2017	Completed research projects and Final Reports due to Metropolitan. MWD Expo featuring student projects, presentations and prototypes

References

[1] Goodman, Community and Economic Development, Master thesis, Massachusetts Institute of Technology, 2011

[2] Kristin N. Dzurella, Josué Medellín-Azuara, Vivian B. Jensen, Aaron M. King, Nicole De La Mora, Anna Fryjoff-Hung, Todd S. Rosenstock, Thomas Harter, Richard Howitt, Allan D. Hollander, Jeannie Darby, Katrina Jessoe, Jay Lund, G. Stuart Pettygrove, Nitrogen Source Reduction to Protect Groundwater Quality, Center for Watershed Sciences,University of California, Davis, July 2012

[3] Rakocy, J., Masser, M., Losordo, T., Recirculating Aquaculture Tank Production Systems: Aquaponics-Integrating Fish and Plant Culture, SRAC Publicatation No. 454, 2006

[4] Tyson, R. V., Reconciling pH for Ammonia Biofilteration in a Cucumber/Tilapia Aquaponics System Using a Perlite Meduim, PhD thesis, University of Florida, 2007

[6] https://apps.ams.usda.gov/fooddeserts/fooddeserts.aspx

[7] Blue Covenant, Maude Barlow, The New Press, 2007

[8] http://www.ers.usda.gov/topics/farm-practices-management/irrigation-water-use.aspx

IDENTIFYING QUANTITATIVE BENEFIT PROJECTIONS

PERFORMANCE MEASURE	QUANTITATIVE OUTCOME	LOCAL / GLOBAL IMPACT
Makes More Water Available	Acre Feet/Year	Local
Reduces Water Treatment Costs	$ / Year	Local
Reduces Per Capita Use	Gallons/Capita/Day	Local
Provides Technical Training	Hundreds of People	Local
Provides Water Conservation Education	Hundreds of Students In the college and k12 institutes	Local
Improves equitable access to fresh drinking water and/or sanitation practices	Hundreds of people	Local
Improves the environment and sustainability benefits for people	Hundreds of people	Local

FINANCIAL CRITERIA

Matching Funds: 2500$ matching funds is on faculty and students voluntary time

Administrative (College) Overhead: There is 909$ college overhead.

Material and Supplies: 3500$ (Fish tank, liner, pump, fish, crop, piping, data logger)

Stipend: 5500 $ (Faculty and student time)

BUDGET OVERVIEW

DESCRIPTION	AMOUNT	NOTES
GRANT FUNDS REQUESTED	10000	909 $: College Overhead 9091$: Stipend and material
Matching Fund	2500	Faculty and student voluntary time
PROJECT TOTAL	12500	

BUDGET BREAKDOWN

Dear World Water Forum Colleges,

This budget template is a sample / guide. Your line items may vary; however, you must **calculate the per unit cost**. Feel free to add or delete line (items) on this document.

DIRECT COSTS						
	COMPUTATION					
BUDGET ITEM DESCRIPTION	**PRICE/RATE**	**UNIT**	**QTY**	**MWD/ WWF**	**College**	**TOTAL COST**
SALARIES AND WAGES						
Faculty Stipend						$3,500
Student Stipend						$2,091
Subtotal			**Subtotal**	$0	$0	$5,591
SUPPLIES/MATERIALS - Describe all major types of supplies/materials, unit price, # of units, etc., to be used on						
Fish tank, Pipings, solar panels crops, pump, data logger						$3,500.00
Subtotal			**Subtotal**	0	$0.00	**$3,500.00**
CONTRACTUAL/ CONSTRUCTION						
INDIRECT COSTS -						
College overhead					**$909.00**	**$909.00**
Matching fnd					**$2,500.00**	**$2,500.00**
Subtotal				**$**	**$**	**$3,409.00**
TOTAL INDIRECT COSTS				**$**	**$**	**$**
TOTAL ESTIMATED PROJECT/ACTIVITY COSTS:				**$**	**$**	**$12,500.00**

SIGNATURE BLOCK

	NAME / TITLE	SIGNATURE	DATE
Faculty Project Manager	Dr. Maryam Shafahi		
College Contracts Officer / Administrator	Dr. Frank Ewers		
Student Project Manager	Jordan Jarnagin		