*Please submit this completed application, the supplemental budget spreadsheet, and any relevant supporting documentation by the deadline indicated in your Step 1 notification letter to* *Sustainability-Committee@Illinois.edu**.The Working Group Chairs will be in contact with you regarding any questions about the application. If you have any questions about the application process, please contact the SSC Program Advisor, Micah Kenfield, at* *kenfield@illinois.edu*

# General Information

**Project Name:** Environment-friendly phosphorus filter from fly ash

**Total Amount Requested from SSC:** $8,350

**Project Topic Area(s):** [ ] Energy [ ] Education [ ] Food & Waste

 [ ] Land [x] Water [ ] Transportation

# Contact Information

### Project Lead

Applicant Name: Rabin Bhattarai

Unit/Department: Agricultural and Biological Engineering

Email Address: rbhatta2@illinois.edu

Phone Number: 217-300-0001

### Financial Contact *(Must be Full-time University of Illinois Staff Member)*

Contact Name: Ronda Sullivan

Unit/Department: Agricultural and Biological Engineering

Email Address: rsully@illinois.edu

Phone Number: 217-244-9528

Organization Code: 741000

### Facilities Management Contact *(If Applicable)*

Contact Name: Name of Applicant or Project Lead

Email Address: Preferred Email Address

**Primary Project Team**

|  |  |  |
| --- | --- | --- |
| **Name** | **Department** | **Email** |
| Rabin Bhattarai | Agricultural and Biological Engineering | Rbhatta2@illinois.edu |
| Keren Wang | Agricultural and Biological Engineering | Kwang54@illinois.edu |
| Ariel Hanon | Agricultural and Biological Engineering | Ahanon2@illinois.edu |
|  | Department/Organization | Email Address |

# Project Description

**Please provide a brief background of the project, the goals, and the desired outcomes:**

*Background*: Subsurface (tile) drainage has helped to sustain the productivity of our farm lands by draining excess water from the field. Excess nutrient losses from our tile-drained agricultural fields have contributed to several water quality issues in the region including the formation of hypoxic zone in the Gulf of Mexico. It has been well-documented that tile drainage is responsible for highly soluble nitrate loss but recent studies have demonstrated that it also contributes to dissolved phosphorus loss from the agricultural fields. Phosphorus (P) has been recognized as the limiting nutrient for eutrophication in most freshwater systems. Filtration is the most common way to remove P from contaminated water. Natural materials and industrial byproducts such as blast furnace slag, iron oxide tailings, coconut shell-activated carbon, zeolite, goethite, bone char, and biochar have been frequently used to facilitate P removal via sorption and precipitation. Fly ash is another potential P filter material since it is rich in Ca, Fe, and Al oxides. One potential problem with the use of fly ash is heavy metal leaching.

*Goals*: We aim to develop ceramic pellets using fly ash and other additives with minimum or no heavy metal leaching. The *specific objectives* of this proposed research project are to: a) optimize the proportion of fly ash and other additives for high P removal and limit heavy metal leaching, b) conduct laboratory experiments to analyze the performance of pellet for dissolved P reduction.

*Outcomes*: The outcome of this research will provide multiple environmental and educational benefits such as reduction in fly ash disposal to the landfill, improved water quality due to reduction in phosphorus pollution, and preparing future generation of scientists and engineers who are well versed in the area of pollution control. Since the results from this research will also be incorporated into the existing curriculum, future students will also benefit from this research.

**How will the project improve the sustainability of the Illinois campus and how will the project go above and beyond campus standards?**

The University of Illinois maintains 5000 acre experimental fields near by the campus. Subsurface drainage has been installed on a large fraction of the farm to increase the agricultural productivity. This system drains not only the excess water from the field making it more fertile but also excess fertilizer including nitrogen and phosphorus from the field. The phosphorus filter developed as a part of this project will help to reduce the phosphorus loss from our fields.

**Where will the project be located? Will special permissions be required to enact the project on this site? If so, please explain and submit any relevant letters of support with the application.**

The project will be located at the department of agricultural and biological engineering. Since the project is focused on laboratory experiments, it will not need any special permission to be required to implement the project. One of the materials needed to implement the project is fly ash which will be obtained from Abbott power plant. Abbott power plant has already offered to help our group with the fly ash (see attached email of support).

**Other than the project team, who will have a stake in the project? Please list other individuals, groups, or departments affiliated directly or indirectly by the project. This includes any entity providing funding (immediate, future, ongoing, matching, in-kind, etc.) and any entities that will be benefitting from this project. Please attach letters of commitment or support at the end of the application.**

The Abbott power plant in the campus has committed to support the research team by providing the fly ash to make the phosphorus filter. Please see attached letter of support (in the form of the email communication).

**Please indicate how this project will involve or impact students. What role will students play in the project?**

Exposing undergraduate students to research is one of the most effective mechanisms for encouraging the pursuit of scientific careers. Ariel Hanon and Karen Wang are two undergraduate students in Agricultural and Biological Engineering who will be working on the project as undergrad hourly during fall 2017 and spring 2018 semesters. They will be responsible for the project activities including setting up and conducting experiments, and writing report/scientific article under the guidance and supervision of Dr. Bhattarai. They will also present the project result at the Engineering Open House (EOH) in spring 2018. They will also be encouraged to compete in undergraduate research symposium both on and off campus.

# Financial Information

*In addition to the below questions, please submit the supplemental budget spreadsheet available on the Student Sustainability Committee website. Submission of both documents by the submission deadline is required for consideration of your project.*

**Have you applied for funding from SSC before? If so, for what project?**

We have never applied for SSC funding before.

**If this project is implemented, will there be any ongoing funding required? What is the strategy for supporting the project in order to cover replacement, operation, or renewal costs?

Please note that SSC provides funding on a case by case basis annually and should not be considered as an ongoing source of funding.**

The aim of this project is to develop and evaluate a soluble phosphorus filter in the laboratory setting. The next step is to evaluate the product in the field setting. We plan to submit research grants to relevant agencies like National Science Foundation, United States Department of Agriculture, and Environmental Protection Agency for the field evaluation for the product evaluation in the field setting. We have already submitted a proposal to the United States Department of Agriculture for conducting the field testing of our product.

**Please include any other sources of funding that have been obtained or applied for. Please attach any relevant letters of support as needed in a separate document.**

As mentioned earlier, the potential sources of funding to continue our research are National Science Foundation, United States Department of Agriculture, and Environmental Protection Agency for the field evaluation. We have a pending proposal with the United States Department of Agriculture for conducting the field testing of our product. Similarly, another proposal has been recently submitted to People, Prosperity and the Planet (P3) student design competition from the Environmental Protection Agency for the product development and testing.

# Environmental, Economic, and Awareness Impacts

*In addition to the below questions, please indicate specific measurable impacts as applicable on the supplemental budget spreadsheet.*

**Which aspects of sustainability does your project address, and how? Does the project fit within any of the iCAP goals? If so, how does the project go beyond the university status quo standards and policies.**

The project addresses the issue related to the sustainability of water resources. The project aims at improving water quality by reducing phosphorus load in water. Excess phosphorus has been attributed to the formation of algae and dead zone in lakes, ponds and rivers. The project goal is well aligned with the following iCAP water and stormwater goal: “*Investigate the water quality impacts of stormwater runoff and potential ways to reduce stormwater pollutant discharges by FY18*”.

**How will the environmental impacts of your project be measured in the near and long term? What specific monitoring and evaluation processes will you be using to track outcomes and progress?**

The short-term environmental impacts of the project will be measured in terms of amount of dissolved phosphorus removed from water. We will quantify the amount of phosphorus present in the water and the amount removed by our product. We expect that the phosphorus removal efficiency of the product will go down with the time. So, we will also quantify the product saturation time in terms of phosphorus removal.

**What is the plan for publicizing the project on campus? In addition to SSC, where will information about this project be reported?**

The student involved in the project will present the result at the Engineering Open House (EOH) in spring 2018. They will also be encouraged to compete in undergraduate research symposium both on and off campus. Student researchers also plan to compete at the KK Barns undergraduate research competition at the American Society of Agricultural and Biological Engineers (ASABE) annual conference in 2018 summer.

**What are your specific, measurable outreach goals? How will these be measured?**

The outreach goal will be measured in terms of various conferences, workshop and student competition the students will participate. We will also track the total number of audience reached during these events.

**Do you have any additional comments or relevant information to aid in evaluation of this application?**

Please provide any additional information here.