Undergraduate Student Research Opportunities and Economic Revitalization through Urban Agriculture Initiatives

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Abstract

Through interactions with the recently formed Cooperative of the Institute of Urban Agriculture and Nutrition (CIUAN), a catalyst initiative co-governed by community organizations and academia to engage in mutually beneficial research and teaching projects, Marquette University in Milwaukee, Wisconsin, is supporting community efforts to bring healthy food to urban environments. This paper will discuss an innovative model, Sustainable Research and Economic Development model, to involve undergraduate students in interdisciplinary community-based research exploring pathways for urban agriculture and urban farmers markets to turn blighted properties into gardens, or rice paddies, as part of a larger metropolitan community economic development effort.

Keywords
Academic Business Model; Community Partnership; Sustainable Research

Introduction

The October 2016 Coalition of Urban and Metropolitan Universities (CUMU) meeting in Washington D.C. had the theme of *Charting the Future of Metropolitan Universities*. The theme aligns with CUMU's focus on "*developing new responses to the pressing educational, economic, and social issues of the day*". As a faculty member in the Department of Biological Sciences at Marquette University, a private urban and Jesuit University in the heart of Milwaukee, Wisconsin, the author attended the conference for the first time and presented a seminar with the same title as this paper. It outlined a sustainable research and business model, using community-based participatory methods, involving urban agriculture organizations in the vicinity of our university (22nd Annual Conference Program, p. 18). Community-based participatory research, also known as CBPR, is "a collaborative approach that equitably involves…community members, organizational representatives, and researchers in all aspects of the research process" (Israel et al., 1998).

The new Sustainable Research and Economic Development (SRED) model incorporates: (a) undergraduate student-centric research; (b) community-based projects designed with urban community partners: (c) interdisciplinary interactions such as biology, economics, and engineering within the university; and (d) the potential for community development and revitalization. Beyond being a replicable model that could be adopted at any urban or metropolitan university embedded in a community practicing urban agriculture, a desired outcome from this approach is to break down silos not only within the institutions of higher

education themselves, but also between the universities and their surrounding communities. It also introduces a methodology for academics to become less dependent on grant funding, at a time when such funding is decreasing and is therefore fiercely competitive.

The SRED model was created in response to the "Strategic Innovation Fund", a newly formed competitive grants initiative at Marquette University, developed under the leadership of its President Michael Lovell. The Strategic Innovation Fund provides seed funding to students, faculty, or staff to pursue entrepreneurial ventures (Research and Innovation 2016). This grant has a premise similar to what venture capitalists expect, which is that the funded projects become self-sufficient and sustainable beyond the funding period. The structure is uncommon for academic scholars who are accustomed to attracting research grants that, in order for funding to be renewed, require that objectives to be met, data be generated, and outcomes be published within the larger scientific community. Thus, a main challenge for faculty is to develop projects that will generate revenues after the seed money runs out. Two standard approaches to generating revenue include attracting extramural funding (the traditional route), or, convincing a business to investment into a follow-up project. However, as described in this paper, an innovative third approach is to develop a sustainable marketable product that generates revenue for reinvestment.

The third approach can have many forms, but the SRED model proposed here, focuses on three main pillars: *community partnership*, *student research activities,* and *sustainable business development*. The SRED model has to have a research theme conducive to student centric research, and the research has to support the development of a commercial product that can be sold for revenues. Because most research scientists are not familiar with the commercialization of a product or general business practices, the SRED model is inherently interdisciplinary and requires strong dialogue between faculty and administrators who can mediate between different disciplines. The following overview involves student-centric research (mostly in the area of biology and agriculture), interdisciplinary collaborations on an urban university campus between different departments and colleges, as well as development of fee-based training workshops and a commercial product, both of which will provide revenue for reinvestment. The project is based on research activities investigating the cold-tolerance mechanisms of Asian rice that will be translated to urban and suburban agricultural settings. The project will most likely lead to the development of cold-tolerant rice cultivars that can be commercially grown as a novel crop in Wisconsin. Further, the potential exists for Asian rice to be grown on vacant city lots and on empty rooftops in metropolitan areas, which would promote community development and urban revitalization.

Sustainable Collaboration with Community Partners

The first pillar of the SRED model, *community partnership*, is to establish a trusting partnership between academia and the community. In CBPR parlance, building a community partnership requires mutual respect, transparency, hearing community priorities, learning together, and taking collective action (Blacksher et al., 2016). To implement a project using the SRED model with equitable partnership of community partners, it is advisable for metropolitan universities and urban communities to develop a catalyst or incubator type of organization that brings

community partners and academia together on a leveled playing field, such as the University City Green organization (James et al., 2010). In the innovative case in Milwaukee, described here,, leaders from the thriving urban agriculture movement in the city (Ghose & Pettygrove, 2014), community organizations involved in food security/insecurity, along with representatives from urban academic institutions, came together to establish an Institute of Urban Agriculture and Nutrition (IUAN), which was recently incorporated as a Cooperative (apps.uwm.edu/iuan; see timeline). IUAN is co-governed by academics and community organizations to guarantee equity of all participants. Through IUAN, Marquette University formed a partnership with Alice's Garden, a two-acre urban community garden located two miles from Marquette, which is run by the University of Wisconsin-Milwaukee County Extension system (Broadway, 2009). Alice's Garden nurtures families and organizations to reclaim and nourish cultural and family traditions connected to land and food. An online article by IUAN chronicles how the cooperative identified common interests between a biologist at Marquette University and Venice Williams, executive director of Alice's Garden, in establishing a mutually beneficial program centered on bringing Asian rice as a potential crop to urban gardens. And furthermore, it recounts how it facilitated the partnership between academia and an urban community organization (Grow, 2014). Introducing a new staple crop to Alice's Garden, to help solve food access problems of the primarily African-American community it serves, was not the only objective for Ms. Williams. She was equally interested in bringing awareness to the history and culture of rice cultivation in the United States. For example, few people are aware that West African slaves who developed the Gullah culture in South Carolina also established commercial rice cultivation in North America (Carney, 2001), and Ms. Williams considered this to be critical historical information to share with the community served by the garden.

The collaboration between Marquette University and Alice's Garden started in 2014, when a group of urban gardeners, mentored by a Marquette University scientist, built two raised-bed-type rice paddies. This became a prototype for the potential of urban rice cultivation in Milwaukee. These paddies followed a design developed at Marquette University to experimentally grow rice in approximately 20-square-foot raised beds, containing pool liners, on a rooftop of the Department of Biological Sciences. At the same time, students of the Bio 3406 "Plant Biology" course, gained a service-learning component, having been previously introduced to plant growth and development only through textbook and primary literature based case studies. The Marquette University students are now an integral part of Alice's Garden, tending one designated plot, as they collaborate with a group of resident gardeners to perform harvesting, weeding, and garden plot winterizing activities every fall semester. The raised bed paddies are now a showcase for rice cultivation, history, and culture, which is reinforced through community conversations at the garden during the summer growing season.

These initial collaborative interactions, based on passion and mutual interest between community partners and university researchers, are crucial for developing a SRED model, because they help develop valuable trusting relationships between the two partners, and set the foundation for building larger scale projects. It is essential that faculty members of metropolitan universities hear the community priorities (Blacksher et al., 2016). Furthermore, faculty must engage in research projects that are useful for and have a resonance in the community, thus ensuring mutually beneficial collaborations. In the case presented here, introducing community gardeners to a new and interesting crop with historical and cultural significance was the foundation that

took research activities out of the lab and into the urban setting. Paired with service-learning activities, it built a bridge between academia and the community. It was a prerequisite for the next step, to discuss projects with fundable objectives. It was important for the current model that at least one part of the project had a sustainability aspect to allow the initial *pro bono* collaboration to evolve into new directions that require capital. In the case discussed here, research to develop cold-tolerant rice varieties not only gives urban gardeners a new crop, but also allows university students to sell this crop at local famers markets, and in local grocery stores, to generate revenues to fund future research. However, in order to cultivate rice and develop other deliverables that can be commercialized, lack of venture capital for infrastructure needs, such as critical hardware and software, can be limiting factors. Therefore, grant funding is crucial for the success of this academic-community partnership model. In this case, the Strategic Innovation Fund initiative at Marquette University provided the seed funding to institute the infrastructure, and serves as a template for other metropolitan universities.

Student Centric Research with Community Partners

The second pillar of the SRED model is the involvement of undergraduate *students in research activities*. For a tuition driven metropolitan university such as Marquette University, active involvement of undergraduate students in research and community partnership programs can be an attractive tool to recruit and retain talented students (Cress et al., 2010). Moreover, for a Jesuit university such as Marquette, student-centric research with community partners fits well into the University's new 4-part strategic plan: *Pursuit of Academic Excellence for Human Well-being*; *Research in Action*; *Social Responsibility and Community Engagement*; and *Formation of the Mind and the Heart*. This SRED model has the potential to advance metropolitan universities as highly ranked destination universities by attracting interested students into specific programs offered by those institutions.

For instance, the SRED model discussed here can serve as an efficient recruitment tool for students interested in interdisciplinary majors such as the recently introduced Environmental Studies major at Marquette University. This new major integrates biological sciences with political sciences, philosophy, anthropology, and economy. Marquette students participating in the described rice project will have the opportunity to put into action what they learn in the new major. The SRED model will advance Marquette University's commitment to research and scholarship by promoting interdisciplinary student-centric research. Furthermore, because of its first pillar to establish true partnerships between academia and the community, it will distinguish the university, following its path for its ethics, service, and promotion of justice through community outreach and training services. In the case of Marquette University, it will define what is called "*The Marquette Experience*" as personally transformative and grounded in the practice of Jesuit spirituality and pedagogy, by providing interdisciplinary study tools for students to examine their own lives in the context of the needs of the local community and the world.

Of course, the specifics of student-centric research projects as part of the SRED model will be different for other universities and not limited to urban agriculture projects. It is advisable, however, to follow a three-year path to self-sufficiency if interdisciplinary research is the central

tenet of the project. In the example of urban agriculture, infrastructure needs have to be addressed in the first year, specifically, raised seed beds, garden plots, perhaps hoop houses, and for rice cultivation, paddies need to be built during the off season of the first year. Other infrastructure needs include the procurement of farm equipment such as planting, harvesting, and crop processing tools. Personnel needs must also be addressed in the first year. The model suggested here offers undergraduates paid internships to enhance their research experience without academic pressure. However, students should also be encouraged to enroll in independent study to get academic credit for the research they perform. An ideal situation is to engage sophomores or juniors in both paid internships and credit-based activities over the course of 2-3 years, which enhances their experiences inside and outside the laboratory. For a rice cultivation seed grant project, the specific three-year timeline is as follows:

In the first year, participants purchased the necessary farm equipment, then constructed and tested two half-acre rice paddies. To do this, a collaboration with another community organization interested in providing healthy food to the urban community surrounding Marquette University was established. The organization is called the Fondy Food Center, because the farmers market it runs is on Fond du Lac Avenue in close proximity to Alice's Garden (Broadway, 2009). Fondy provides farm land located 20 minutes north of Milwaukee to farmers who sell their harvest at its farmers market. The leaders of Fondy share the vision that rice can be introduced to our urban community as a healthy staple crop, particularly when it is sold as brown rice, which, based on informal polling, is in high demand at the farmers market. A cohort of 10 biology and engineering student interns, Fondy personnel, and contractors are hired in the first year to build two perfectly leveled paddies on Fondy farm land. The students are selected from applicants responding to advertisements of the internship during classes and on university employment websites. The paddy construction part is done by a contractor with assistance from engineering students. The Fondy Farm manager instructs biology students in basic agricultural practices; A Marquette University scientist teaches them rice cultivation practices. Then, to ensure controlled flooding, water is pumped during the growing season from two holding ponds adjacent to the paddies. At the same time, small rice planting, harvesting, threshing, and rice hulling equipment is purchased to have the two paddies fully operational by the end of the first year. The equipment is mobile, so Fondy provides a barn next to the farm for secure storage. Because the first year requires a significant amount of capital investment for the sustainable rice business model, a team of 2-3 business student interns keep track of all costs involved, including student time commitments to estimate labor costs, contractor expenses, and equipment costs that will be incorporated into a general business plan (see below).

In the second year, biology student interns perform research experiments on different rice planting methods, such as direct grain seeding versus seedling transplantation methods. They test how different planting densities affect yield. Initially, students use a preselected, relatively cold-tolerant rice variety, and also perform research in the lab and on the farm to identify genetic components that improve rice cold-tolerance through future breeding efforts. After harvesting and processing, students measure paddy rice yields during the winter months to determine best practices for rice cultivation, and incorporate this into the general business plan. These research activities lead to publications for students and faculty mentors in peer-reviewed scientific journals. Simultaneously, engineering and business students assess the feasibility of building and selling small-scale electric hullers that could be marketed to prospective rice farmers. Their

conclusions will be incorporated into a general business plan to provide different business options.

In the third year, student interns continue their rice cold-tolerance experiments in one of the paddies and use the other to put the best rice cultivation practices into action to produce the first commercial harvest. This harvest will be sold to generate revenues to continue the project beyond the seed grant-funding period. Business students will keep track of operational costs such a labor for rice planting, tending (fertilization, weeding, pest control), processing, packaging, and storage of rice before it is sold. Students will also perform market research to determine competitive product pricing, the effect of promotional purchase incentives, and to track sales based on variables such as season of the year or ethnic holidays. These data will help assess how the urban community, for example, customers of farmers markets, benefit from this SRED project, and how the community helps direct the project in this phase.

Establishing Sustainable Business Models

The third pillar of the SRED model is to *develop business models* for student researchers and the urban agriculture community. The major sustainable aspect of the model is to continue research on a marketable product. In the case described here, the product will be cold-tolerant varieties of rice with high yield potential in a cold climate. Such rice can be sold at urban farmers markets and local grocery stores and restaurants interested in reducing food production carbon footprints by providing locally grown food. However, interdisciplinary research presents additional opportunities for development of commercial products. For the rice project, collaborations with the Engineering department may lead to the development of small-scale rice farming equipment conducive to urban agriculture. As an example, Mechanical Engineering students registered for senior design capstone classes can be mentored to design table top rice hullers that would be attractive to urban gardeners who want to process their own rice. After addressing intellectual property issues, such devices could be manufactured, sold, and even patented.

Another example is to involve student interns from the business school to develop several types of business plans that can be sold to prospective rice farmers. One plan would address the investment needs and potential returns for rice cultivation in urban gardens. Another plan would address the needs and returns for small-scale suburban farming, potentially in association with a community partner such as the Fondy Food Center. To put this into perspective, one acre of rice and appropriate farming techniques could yield up to 8,000 pounds of paddy rice, generating approximately 6,000 pounds of hulled brown rice. Therefore, for the one-acre rice paddy used in the SRED model described here, the main goal would be to generate at least 5,000 pounds of rice sold for an estimated $3-4 per pound to generate yearly revenues of $15,000-20,000. Yields in urban gardens will depend on the square footage used for rice cultivation (for instance, 200 square feet might yield around 30 pounds of brown rice). Another product could be a “kit” for urban gardeners who want to explore the option of cultivating rice in rooftop paddies, which would include the material to build the paddies, soil, rice seeds, a detailed cultivation manual, and fee-based access to rice hulling equipment run by Marquette University students.

To promote economic revitalization opportunities in a community interested in urban farming, the SRED model proposes development of not only business plans and cultivation manuals, but also workshops and training modules for residents seeking to supplement their income with rice farming. In the case described here, Alice's Garden will be a hub for those training activities, and a new rice-farmertraining track is already offered through the garden's outreach activities. The long-term goal is that interested gardeners and residents can register for fee-based training courses and workshops, after which they will also receive appropriate business plans and guidance on how to apply for loans to establish their own rice business. There will be an incentive for residents to use empty city lots and rooftops for such business ventures, which will contribute to economic revitalization, may boost property values, and will beautify the urban landscape (Urban Agriculture, 2017).

Another sustainable aspect of the SRED model is that fee-based education, labor, and consulting services can be bundled with equipment sales, providing a pathway for farmer success, as well as additional revenue for project maintenance costs as well as reinvestment. For example, rice hulling can be offered to the rice farming community as a fee-based service. This can be beneficial for community partners, because they would not have to purchase relatively expensive equipment. It can also be a model for local entrepreneurs who decide to provide these types of harvesting and processing services to rice farmers instead of engaging in farming themselves. Furthermore, a benefit for urban and metropolitan universities that provided the initial seed funding is that they would be entitled to claim some of the revenues generated after the funding period as indirect cost to cover administrative and research expenses the university might incur after the initial funding period.

Conclusions

The three pillars of the SRED model, using an urban agriculture framework, were presented at the 2016 CUMU meeting on charting the future of metropolitan universities.Incorporating feedback from the presentation, they are described in greater detail in this paper. The purpose of this paper is to present a model that can be adopted by any metropolitan university in the country, either in its current form or adapted to other research with the potential to generate a viable commercial product. For the city of Milwaukee and state of Wisconsin, rice is a novel crop that can be stored and sold during winter and has enhanced nutritional value if consumed as unpolished brown rice. Through educational efforts in the urban agriculture center, and cultural hubs of Alice's Garden and the Fondy Food Center farmers market, a desirable outcome of this project is that locally grown brown rice will become an attractive alternative to less nutritional polished rice. This could have a positive impact on the public health of the community surrounding Marquette University. To promote this, additional projects are planned, such as providing recipes for brown rice dishes during annual harvest fests at Fondy, and offering cooking demonstrations during the winter months at local community centers associated with Alice's Garden.

Another purpose for this paper is to demonstrate that the SRED model for community-based participatory research, involving strong partnerships between academia and the urban community, is innovative not only in terms of the three pillars, but also through its

interdisciplinary and multidisciplinary aspects. It not only promotes research, but also provides students with skills to become social innovators, which is an important part of the tradition of many Jesuit metropolitan universities, as well as all urban universities in this country. The particular project presented here will put into action the vision that through student centric research and development activities, a new green industry can be promoted in Milwaukee and beyond that will not only bring new jobs, but also will impact the social, health, and economic aspects of underserved and underprivileged urban residents.

The sustainable rice cultivation model described here has been developed specifically for the Milwaukee community, but the SRED model can be adopted by any metropolitan universities that work closely with their surrounding communities. This is innovative because the investments will return to the universities by attracting motivated undergraduates, paying student interns, and providing some indirect costs for laboratory-based research activities for future research projects. In the case described here, the model promotes research innovation for students, who will participate in cold-tolerance research and breeding efforts. It is hoped that their efforts will generate patentable superior rice lines for the cold Wisconsin climate. The SRED model not only provides paid student internships, but also for-credit independent research opportunities in biology, environmental studies, engineering, and business. This model allows Metropolitan Universities to sponsor faculty and students to go beyond the boundaries of academia to pursue excellence for human well-being through community engagement and research activities, while at the same time remains financially self-sufficient to continue training the formation of the mind and the heart of their highly talented student bodies.

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References

Blacksher, E., Nelson, C., Van Dyke, E., Echo-Hawk, A., Bassett, D., and Buchwald, D. (2016, Summer). Conversations about community-based participatory research and trust: "We Are explorers together." *Progress in Community Health Partnerships: Research, Education, and Action* 10(2), 305-309. doi.org/10.1353/cpr.2016.0039

Broadway, M. (2009, December). Growing urban agriculture in North American cities: The example of Milwaukee. *FOCUS on Geography* 52(3-4), 23-30. doi.org/10.1111/j.1949-8535.2009.tb00251.x

Carney, J. (2001). *Black rice: The African origins of rice cultivation in the Americas*. Cambridge: Harvard University Press.

Cress, C., Burack, C., Giles, D.E., Elkins, J., and Stevens, M.C. (2010). A promising connection: Increasing college access and success through civic engagement. Boston MA: Campus Compact.

Ghose, R. & Pettygrove, M. (2014). Urban community gardens as spaces of citizenship. *Antipode* 46(4), 1092-1112. doi.org/10.1111/anti.12077

Grow. (2014). Rooftop rice project connects scientist and visionary leader. Retrieved from http://apps.uwm.edu/iuan/community-collaboration/good-food-cycle/grow/

Israel, B., Schulz, A., Parker, E., and Becker, B. (1998). Review of community-based research: Assessing partnership approaches to improve public health. *Annual Review Public Health* 19, 173–202. doi.org/10.1146/annurev.publhealth.19.1.173

James, P., Maslin, M., Pringle S.M., and Van Clief, B. (2010). University Green: How Urban Forestry Partnerships Plant More Than Trees. Metropolitan Universities Journal 20(4), 75-86. Retrieved from https://journals.iupui.edu/index.php/muj/article/view/20410

Research and Innovation. (2016). Strategic Innovation Fund. Retrieved from http://www.marquette.edu/innovation/strategic-innovation-fund.php

Urban Agriculture. (2017). *Research: Social, Health, and Economic Impacts of Urban Agriculture*. Retrieved from http://ucanr.edu/sites/UrbanAg/Research/

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