Title: Sustainable Agricultural Food System Update

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This document is meant to serve as the 2nd phase update to the original proposal submitted during the Spring 2013 funding period. The proposal was split into 3 phases, the first of which was approved Spring 2013. A great deal of progress has been made in the project, and some proposed changes to the 2nd and 3rd phases of this project are outlined in this document, along with the budget sheets attached.

Phase 1 Update:

Phase 1 included the procurement of necessary equipment to produce tomato sauce from a raw tomato grown on the Student Sustainable Farm (SSF), and development of a satisfactory package for the finished sauce. The details of this work are below.

1. Capital Expense: Equipment

1. Fruit/Vegetable Washer – Ordered, awaiting delivery (to be shipped with hot break tank)
2. Hot Break Tank – Ordered, awaiting delivery (custom design being manufactured)
3. Diaphragm Pump – Ordered, awaiting delivery
4. Pulper/Finisher – Delivered and installed
5. Vacuum Steam Kettle – In University bid process

2. Education/Training: Summer Intern

A summer intern (Yun Liang) from the FSHN Professional Science Masters (PSM) program was hired to investigate packaging options, conduct trials on the pulper/finisher, and evaluate different tomato varieties. Yun gathered important information about sustainable farming and food processing practices when working with client companies to evaluate packaging equipment. This internship was valuable to the student as she received advanced knowledge and skills in sustainable farming practices and tomato processing. Additionally, her efforts were crucial to the determination of the optimal packaging solution. Meetings were held with several faculty members, the SSF, Dining Services, and Marcus Ricci (former SSC member) to assist in her efforts.

3. Other Related Activities

1. Brian Jacobson, Yun Liang, and several FSHN students worked with the SSF to test tomatoes grown in 2013, with the newly purchased equipment. To date, the pulper/finisher has been found to be the most critical step. We were able to run dozens of trials to find an optimum configuration for the equipment. We conducted capacity trials, and these data were critical to appropriately sizing the rest of the stage 1 equipment as well as equipment for stages 2 and 3.

2. Dr. Juan Andrade and Xie Xin (Visiting Student from Zhejiang University, China) characterized different varieties of tomatoes grown at SSF, based on their properties for tomato puree utilization. A combination of pilot scale and lab scale equipment was utilized to analyze tomatoes for the following: percent yield by weight, moisture, pH, brix (soluble solids), and viscosity. These data will allow us to choose the optimum varieties of those grown at SSF for use in processing.
3. Equipment associated with this funded project (stage 1) was utilized by the University of Illinois, Urbana-Champaign (UIUC) Dining Services in their successful Guinness Book of World Records attempt to make the world's largest bowl of salsa. Approximately 7,000 lbs of tomatoes, onions, and peppers from the SSF were processed through the equipment in the morning of new student convocation.
4. Dr. Bruce Branham (Crop Sciences) and graduate student Kevin Wolz utilized the new pulper/finisher and existing Pilot Plant equipment to produce grape juice on several occasions, in anticipation of making a product for Dining Services with next year's crop. New products are being planned based on the types of produce being grown from Dr. Branham's woody perennials near the SSF. This has initiated further discussions regarding a broader range of products that may be processed in partnership with the Pilot Plant and SSF.

4. Recommendation for Packaging

Based on work conducted to date and findings regarding optimal processing, it is recommended that a retortable pouch packaging option be utilized in future work. This will require that a new retort capable of handling plastic pouches with several different agitation options be purchased. Additionally, a pouch filling/sealing system with liquid loader will be purchased. Both of these pieces are very flexible for handling other products.

There are many reasons for this retortable pouch recommendation; the most compelling of which includes product security. This is the safest way to produce unadulterated, shelf-stable sauce, while reducing waste associated with traditional food cans, and also allowing for the greatest flexibility in handling additional products, both from the SSF and the FSHN department. Moreover, as graduate and undergraduate trainees are further involved in experiences with conversion of SSF materials into edible foods, this retortable pouch packaging will ensure that optimal raw and processed food handling procedures are implemented. These retortable pouches are also the preferred container for Dining Services and are becoming commonplace in the Food Industry as a whole due to their much lower carbon footprint than standard aluminum cans. Yun Liang and Brian Jacobson met with a former member of the SSC (Marcus Ricci) in July 2013 to discuss different packaging options, and Mr. Ricci agreed with this assessment. Based on experience and evidence, this process will be the most effective and efficient among the available options.

5. Concerns

The only additional concern not present during the initial application stage of this project is in regards to purchasing. The more expensive items have longer than anticipated lead times to procure due to University purchasing requirements. We are working with the business

office to ensure we are able to procure the necessary additional equipment in as timely a manner as possible.

6. Summary

In summary, stage 1 of the Sustainable Agricultural Food System has been a great success. The project has progressed as planned, and many positive additional activities have taken place as a result of the progress so far. We look forward to continued funding and moving into Phase 2 of the work.

Phase 2 Summary:

Phase 2 is a logical progression of the work in Phase 1. After the sauce is produced, it must be packaged and made shelf-stable. This funding request includes the packaging equipment we believe best fits the criteria established during Phase 1; food safety, sustainability, and flexibility for other products. Based on some things learned during the work of Phase 1, there are some suggested modifications to the proposal outlined below and on the attached documents.

1. Packaging

The current standard package for sauce products in food service is a 1 gallon metallic can. These cans are generally recyclable, but have a very high carbon footprint during transportation due to their bulky size and weight, even when empty. There is also high cost incurred during production of metallic cans both from virgin steel or recycled materials. The food industry is slowly moving away from these cans due to the high environmental costs compared to alternatives that are emerging on the market.

Two other alternatives that were reviewed were cartons and glass jars. Cartons have become popular in the consumer market, but are struggling in the food service business. It is difficult to make cartons large enough to hold a desired quantity of product, so many small cartons must be used, increasing the total amount of packaging material. Cartons are recyclable in some places, however it is still an expensive process to separate the different layers in the carton. Glass jars are not recommended due to their inherent safety concerns. To be considered a sustainable package, they must be reused in our system, and this is simply not feasible. The glass must be sanitized after each use, which is a very costly and dangerous process. The glass is cooled and heated quickly, causing a portion of the jars to shatter each cycle. This glass is then present in the food processing equipment and can contaminate the finished product. Equipment to identify glass shards inside of filled jars is used to combat this problem, however it is extremely expensive. Outside of the disadvantages outlined above, the equipment for both glass filling/handling and carton filling is extremely expensive, placing it well outside the scope of this project.

As detailed in item 4 (Phase 1) above, a plastic retortable pouch will be the ideal package for the tomato sauce product. The equipment is reasonably priced, and very flexible for adding additional products in the future. The equipment specified can package liquid type products in pouches as small as a ketchup packet commonly found in fast food restaurants, up to a

12”x13” pouch. Many different films are available, able to handle products such as; sauces, purees, raw/chopped fruits/vegetables, grains, extruded puffs, flours/powders, lettuce type products, jams, etc. Many of these films are recyclable. Additionally, the films have a very low carbon footprint due to their minimal size and weight. When empty, hundreds of plastic pouches can fit inside the space occupied by a single 1 gallon can or jar, greatly minimizing fuel consumption during transportation. Additionally, the weight of the plastic film is much lighter than a metal can, and can be much more easily stored.

The plastic pouch is unparalleled when all factors are considered. It allows a safe, shelf-stable product to be made consistently, has a much lower carbon footrprint than other available options, and allows for tremendous flexibility in adding additional products that could be produced using SSF materials. The food industry is moving many products to this type of package for these reasons, so it is also well accepted within UIUC Dining Services and other food service facilities.

2. Budget Changes

Many things were learned during the trial runs and equipment procurement of Phase 1, so an updated budget is provided. The changes for Phase 2 and 3 are on the attached budget sheet and explained below.

Phase 2

- Removal of Packaging Equipment and Sterilization (Heat Exchanger) Equipment. Addition of Pouch filling/sealing machine and Multi-Function Retort.
    - This equipment was originally included as a placeholder for anticipated cost. The change is to update the actual equipment as outlined above.
- Metal Detector budget increase
    - This increase is due to a misjudgment in the cost of this equipment.
- PSM Internship
    - This change was made to move the internship forward to this funding cycle as opposed to Spring 2013. The announcement of funding from the SSC in the Spring semester is near the end of the semester, making it difficult to find a qualified candidate as most students already have internships lined up by that time. This would allow for a desirable internship to be available to the students before they accept less desirable placements, and allow the project the opportunity to hire a more qualified student.
- Hookup of Equipment
    - Moved to Phase 3 as the Phase 2 equipment will not be delivered until after the Phase 3 funding cycle. The money is unnecessary until that time.
- Recipe Testing Materials
    - Moved to Phase 3 as the Phase 2 equipment will not be delivered until after the Phase 3 funding cycle. The money is unnecessary until that time.

Phase 3

- Advertising materials
    - Removal of budget due to arrangement with Dining Services. Dining utilizes digital signage and existing signage on their food products that can be utilized for this project.
- Estimated work to meet IDPH requirements
    - Removal of budget due to FSHN department initiative to improve Pilot Plant space. This funding is no longer necessary.
- Hookup of Equipment
    - Moved to Phase 3 as the Phase 2 equipment will not be delivered until after the Phase 3 funding cycle. The money is unnecessary until that time.
- Recipe Testing Materials
    - Moved to Phase 3 as the Phase 2 equipment will not be delivered until after the Phase 3 funding cycle. The money is unnecessary until that time.
- IDPH Registration Fees
    - See above regarding IDPH requirements

3. Timeline Changes

This proposal was structured into 3 phases at the recommendation of the SSC during the Spring 2013 semester. Due to the requirements of the project, Phase 2 represents a majority of the cost of the entire project. The budget and timeline are proposed as optimal to the project, but some of the cost burden could be moved from Phase 2 to Phase 3 of the project with minimal negative consequences to the overall timeline.

The current budgets for Phase 2 and 3 are below.

Phase 2 – $387,000
Phase 3 – $25,000

By moving the multi-function retort from Phase 2 to Phase 3, the budgets can be adjusted to the below. This will more evenly spread the funding, and possibly allow for more flexibility for the SSC.

Phase 2 – $87,000
Phase 3 – $325,000

With the delays in procurement currently being caused by purchasing, and the timeline of funding by the SSC, it is doubtful the multi-function retort would arrive in time for Summer 2014 harvest if approved during the Fall 2013 (Phase 2) funding cycle. Moving the funding to the Spring 2014 (Phase 3) funding cycle should not affect our ability to procure the retort by Summer 2015.

UIUC Dining has been very accommodating through this process, and has offered to help minimize the consequences of not having this equipment (retort) by Summer 2014. We have worked out a system in which we believe we can still produce safe tomato sauce to be served at the Dining Halls during this upcoming school year. It is not ideal, and not a process that would be possible on a continual basis. Essentially, the sauce would be produced at the Pilot Plant, and then transported immediately to the Dining Halls for further processing. Without the retort, the product cannot be made shelf-stable, so everything would need to be stored at refrigerated or freezing temperatures. Additionally, the shelf life would be much shorter, forcing Dining to change their menus, and maybe accept less product than if we were able to fully process to shelf-stable. The remaining funding shown in Phase 2 would still be required for this arrangement to work as the packaging equipment would be a requirement for transport of the product.

This temporary arrangement would allow the project to continue, allow the SSF to increase their capacity and profits, and provide a quality, local grown product for the students of the University of Illinois.