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Ashley D. Jones

University of Arkansas, Fayetteville

Jennie S. Popp

University of Arkansas, Fayetteville

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Developing enterprise budgets for sustainable school gardens: Service learning in a global context

Ashley D. Jones and Jennie S. Popp†*

ABSTRACT

Service learning programs are becoming a part of curricula in universities throughout the United States. The University of Arkansas, Fayetteville, (UAF) established a service learning program that targeted the educational, health, social, and agricultural needs of a community. The focus of this research aimed to provide students, faculty, community members, school officials, and students with a template for crop budgets. These crop budgets are used to evaluate the costs and returns of producing multiple crops at a school. Crops produced in a sustainable garden must meet three criteria: 1) have minimal negative environmental impact, 2) provide just-in-time production of quality crops to meet school needs, 3) be solvent, i.e. the garden generates net positive revenue from the sale of crop or provides cost savings by growing crops at the school rather than purchasing them elsewhere. This proposal focuses on developing enterprise budgets for four crops: chili peppers, cabbage, corn, and tomatoes, and an interactive Excel® budgeting tool to evaluate revenues and expenses of crop production. The design of the interactive budgets is to provide a framework that students at UAF can use in their service learning courses when examining the costs and benefits of agriculturally based projects, while also being a functional aid for the recipients of the service learning program.

* Ashley D. Jones is a senior majoring in agricultural economics.

* Jennie S. Popp, faculty sponsor, is an associate professor in the Department of Agricultural Economics and Agribusiness.

MEET THE STUDENT- AUTHOR



Ashley Jones

After I graduated from Lincoln High School in Lincoln, Ark., in 2005, I began my studies in agricultural economics, with a minor in global agriculture, at the University of Arkansas. I was the recipient of the Honors College Academy Scholarship, in addition to other private scholarships provided by the Dale Bumpers College, the Department of Agricultural Economics and Agribusiness, and the Walton Foundation.

I am an active member in the Agriculture Business Club and am currently serving as president. I am also a member of Agricultural and Applied Economics Association Quiz Bowl, Alpha Zeta, Gamma Sigma Delta, and Phi Kappa Phi.

I plan to begin graduate school at Kansas State University in the fall of 2009, to pursue a master's degree in agricultural economics.

This research project was selected because of my involvement with the Belize Service Project in the summers of 2007 and 2008, along with my personal interest in sustainable agriculture in developing countries.

INTRODUCTION

In 2007, the University of Arkansas, Fayetteville, pioneered a new approach to service learning by developing an integrated multi-tasked, multi-year, service-learning program with the objectives of targeting health, educational, agricultural, dietary, social, economic, and environmental needs of a community at the same time. This paper explores the agricultural and food project, a sustainable school garden at St. Matthew's Elementary in Pomona, 10 miles from Dangriga, Belize. The purpose of this research was to create interactive enterprise production budgets for vegetables that could be used in sustainable school gardens in Belize, the U.S., and other countries.

There are several types of budgets, all of which meet different needs and objectives for different users. Basic enterprise budgets give "an estimate of the potential revenue, expenses, and profit for a single enterprise" (Kay, et al., 2004). Budgets can also be modified to fit the user's needs. For vegetable crops, the typical budget is on a per-acre basis. While a paper budget can be useful in computing revenues and expenses for a sample plot, an interactive enterprise budget allows users to modify the budget to fit their needs and compute sensitivity analysis for each crop. Furthermore, interactive budgets that can evaluate multiple crops at one time allow users to determine the most profitable production mix for the planting period. Therefore, the resulting tool serves the dual purpose of being an educational tool for students interested in learning

about budgeting and a practical tool for those planning a garden.

This research focused on the development of an interactive four-crop enterprise budget. For purposes of example, the enterprise budgets were used to evaluate the options for a school garden in Belize. The remainder of this paper describes the development of the budget and presents an example that shows how this budget can be used to: 1) calculate revenues and expenses associated with a school garden; 2) evaluate expenses and returns of multiple crops; and 3) determine which combination of crops results in profit maximization, when faced with constraints such as garden area and expenses.

MATERIALS AND METHODS

This research was conducted in three parts. First, through a literature review, information concerning the important parts of small vegetable enterprise budgets was gathered to serve as a model for developing the budgeting tool and to identify the types of data needed for collection in Belize. An enterprise budget includes two main sections: revenues and expenses. The revenue section of a budget includes crop yield and crop prices to generate total revenue. Expenses are segmented into total variable expenses and total fixed expenses, and then totaled to arrive at total expenses for the project. Variable expenses typically include seeds, pesticides, fertilizer, labor, some irrigation expenses, and interest on capital. Fixed expenses typically

include irrigation, machinery and equipment, and management expenses. Relevant expenses were populated for the Belize example; irrelevant expenses were not.

Second, information to populate the budgets was gathered on-site in Belize during summer 2008. Based on local growing conditions and dietary needs, four crops—cabbage, corn, chili peppers, and tomatoes—were identified for use in the budgets. With assistance from the Belizean Ministry of Agriculture, relevant production practices, production inputs, and expected prices and yields were determined.

Third, four paper budgets—one for each crop—were developed that include the collection production practice, yield, and price information. The paper budgets include three main parts: total revenues, total expenses and profit. The following equations were used to calculate profit for each crop:

$$TR = P_y * Y \quad \text{Eq. (1)}$$

$$TE = TVC + TFC \quad \text{Eq. (2)}$$

$$TVC = \sum_{i=1}^i P_{x_i} X_i \quad \text{Eq. (3)}$$

$$TFC = \sum_{j=1}^j P_{w_j} \quad \text{Eq. (4)}$$

$$Profit = TR - TE \quad \text{Eq. (5)}$$

where TR is total revenue, P_y is output price, Y is yield, TE is total expenses, TVC is total variable expenses, TFC is total fixed cost, P_{x_i} is the price for variable input i , X_i is use of variable input i , and P_{w_j} is price of fixed input j .

Fourth, this information was used to create an interactive budget in Excel® that allowed users to compare the inputs, expenses, and revenues for a model garden to that of their own sustainable school garden (Microsoft, 2007). The budget maximizes profits per acre of land, subject to the percentage of total area for each crop. Other constraints include minimum and maximum area allocation for each crop. These constraints are given by a set of formulas identified within the algorithm. Examples of these formulas are:

$$MaxLand = 1 \quad \text{Eq. (6)}$$

$$\%Pep \leq PepMax \quad \text{Eq. (7)}$$

$$\%Pep \geq PepMin \quad \text{Eq. (8)}$$

where $MaxLand$ is the maximum land available for production (here one acre), Pep is the land devoted to peppers, $PepMax$ is the maximum percentage of land that can be allocated to peppers, and $PepMin$ is the minimum percentage of land that can be allocated to peppers. Excel® then uses an algorithm to determine the optimal mix of

crops that maximizes profits for one acre of land given the identified constraints.

RESULTS AND DISCUSSION

The interactive budget tool is an Excel® 2007 spreadsheet consisting of seven tabs. Four tabs represent the enterprise budgets for each crop. Each budget is comprised of four sections: revenues, variable expenses, fixed expenses, and profits. Variable expenses included: plants and seeds, fertilizers, pesticides, labor, and operating costs. Fixed costs included amortization for irrigation equipment, machinery and other equipment, and management. Users can calculate profit with the default values included in the budgets or they can modify any values to make calculations that are representative of their garden.

The amortization schedule for irrigation was developed in another tab. Information in this tab includes irrigation costs, interest rate, and payment period. The user can adjust all of this information as needed. The input tab of the spreadsheet defines the inner workings of the spreadsheet (such as calculating planting density, yield per area, and output prices) and will not likely be modified by most users.

Finally, the first tab of the spreadsheet is the budget summary. The summary tab displays expenses and returns associated with the chosen mix of crops for production. This tab provides three types of budgeting summaries. The first summary, entitled *Economic Snapshot of My Farm*, provides the revenue, expense, and profit information associated with the user's actual garden situation (Table 1). *My Farm* consists of two acres of production, including 0.65 acres of peppers, 0.45 acres of cabbage, 0.30 acres of corn, and 0.60 acres of tomatoes. Economic returns for these two acres were \$12,451. The second summary, *Economic Returns for One Acre of Each Crop*, illustrates revenues, expenses and returns associated with producing one full acre of each crop. Economic returns per acre were as follows: \$710 (peppers), \$13,449 (cabbage), \$1,636 (corn), and \$9,078 (tomatoes).

Finally, the third summary shows the results of the optimization process. For example, suppose the owner of *My Farm* wants to produce at least some amount of each crop in his garden. The land constraints would be set as a minimum of 5% and maximum of 85% of the land in one crop. Given default prices, yields, and the amortization schedule, the optimal allocation would be 5% of acreage dedicated to peppers, corn, and tomatoes while cabbage would occupy 85% of the acre. The profit associated with this mix is \$12,003 (Table 2). This summary allows the user to conduct sensitivity analysis. For example, if cabbage prices fall from \$1.75/lb to \$1.05/lb, pepper prices increase from \$0.50/lb to \$0.90/lb, and yields fall from 10,000 lbs/acre to 7,000 lbs/acre. In this example, profits for *My Farm* fall

from \$12,003 to \$11,446 and the allocation of crops in the garden move from 85% cabbage to, now, 85% tomato and per-acre profit falls to \$8,272 (Table 3).

The budgets created will provide students in the UAF Service Learning Program with a tool to use when analyzing what mix of crops to produce for the upcoming summer in Belize, while also providing agricultural personnel and school faculty a hard copy form of a budget to estimate revenues for the school, as well as expenses for the project.

Sample budgets will be distributed electronically and in hard copy in the UAF Service-Learning Program curriculum, as well as in Belize. The budgets will be capable of being used interactively through Microsoft Excel®, and can be printed and distributed on paper for use where computers are not easily accessible. This research provided an interactive budgeting tool to help UAF students prepare for agricultural projects in Belize, as well as provided the students with a framework that can be used in their service learning course when evaluating the costs and benefits of agriculturally based projects, while at the same time being useful to the recipients of the service learning program, in this example, the schools in Belize.

Once the budgets were developed, a short “how to” guide was developed to help users navigate their way through the spreadsheets to arrive at their own crop revenues and expenses, as well as to provide answers to frequently asked questions. The guide highlights the types of analysis that can be performed and provides instructions on how to perform them.

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 Microsoft Excel®. 2007. Microsoft Corporation.

Table 1. Economic Snapshot of My Farm.

Economic Snapshot of My Farm—2.00 acres				
	Pepper	Cabbage	Corn	Tomato
Revenues	\$7,150	\$7,875	\$1,248	\$7,500
Costs	\$6,688	\$1,823	\$757	\$2,053
Profits	\$462	\$6,052	\$491	\$5,447
Total Profits (\$/area)				\$12,451

Table 2. Optimization of crop mix across one acre of land, given prices, yields, and amortization.

Optimization of 1 Acre of Land - Crop Mix Composition				
Percentage Area (ac)				
	Pepper	Cabbage	Corn	Tomato
	0.05	0.85	0.05	0.05
Area Constraints				
Variable	Pepper	Cabbage	Corn	Tomato
At least (ac)	0.05	0.05	0.05	0.05
Maximum (ac)	0.85	0.85	0.85	0.85
Max Area (ac)	1.00			
Economic Snapshot for Crop Mix (\$/1 ac)				
Variable	Pepper	Cabbage	Corn	Tomato
Revenues	\$550	\$14,875	\$208	\$625
Costs	\$514	\$3,443	\$126	\$171
Profits	\$36	\$11,432	\$82	\$454
Total Profits (\$/ac)				\$12,003

Table 3. Optimization of crop mix across one acre of land when cabbage price and yields fall

Optimization of 1 Acre of Land - Crop Mix Composition				
Percentage Area (ac)				
	Pepper	Cabbage	Corn	Tomato
	0.05	0.05	0.05	0.85
Area Constraints				
Variable	Pepper	Cabbage	Corn	Tomato
At least (ac)	0.05	0.05	0.05	0.05
Maximum (ac)	0.85	0.85	0.85	0.85
Max Area (ac)	1.00			
Economic Snapshot for Crop Mix (\$/1 ac)				
Variable	Pepper	Cabbage	Corn	Tomato
Revenues	\$550	\$14,875	\$208	\$10,625
Costs	\$680	\$3,443	\$126	\$2,909
Profits	(\$130)	\$11,432	\$82	\$7,716
Total Profits (\$/ac)				\$8,272