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Understanding Profitability of Georgia Blueberry Growers Adopting a Stochastic Approach

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Abstract

We use a stochastic approach to assess the returns from blueberry production regarding observed blueberry price and yield variability. We extend the deterministic budget to stochastic by using triangular distribution and using Monte Carlo simulations. We use net present value (NPV) to assess and compare the returns. We observed disparity in the expected NPVs from two budget systems, and the chance of getting positive NPV studied under the stochastic budget was too low (23.85%–30.24%). This result shows the need for a stochastic approach to analyze growers' profit, which helps making investment decisions. Moreover, this study is useful for farmers and farm risk analyzers.

Keywords: Blueberry, deterministic, simulation, stochastic

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Introduction

Georgia started using its land along with other crops to produce blueberry after 1950 and as of 2018, blueberry production area has expanded to 13,300 acres (USDA NASS, 2019; Scherm and Krewer, 2003). Rabbiteye, southern highbush, and northern highbush are the three types of blueberries grown in Georgia and are best adapted to South Georgia and the mountain highlands, respectively. Blueberry is one of the top 10 fruits and tree nuts commodities in Georgia in terms of farm gate value with a share of 48.87%, and it contributed 2.18% of the total Georgia agricultural farm gate value in 2018 (Wolfe and Stubbs, 2019). Georgia blueberry growers face price and yield alteration due to factors such as selected cultivars used in production, area of production, aggregate productivity, market, and timing (Fonsah and Hudgins, 2007; Fonsah et al., 2007; Fonsah et al., 2011). Despite the variation in price and yield, blueberry growers in Georgia depend on a budget with single-point estimates that best describes the blueberry price and yield. Although such budgets provide farmers useful information about the profitability of blueberry farming, Awondo, Fonsah, and Gray (2017) reported that in a deterministic budget, the grower's profit is overestimated at least three times. As a result, it was imperative to also examine Georgia blueberry production using a stochastic budget system and compare the returns of both systems.

Literature Review

The use of a probabilistic approach in budgeting can be found in numerous studies evaluating animal production (Werth et al., 1991; Gummow and Patrick, 2000; Shalloo et al., 2004; Rayburn, 2009). Evans et al. (2007) compared a pasture-raised beef production system to a conventional system using stochastic budgets. Falk (1994) evaluated a small-scale meat-packing plant in New Mexico using this approach.

However, the application of stochastic budget analysis in the fresh-food industry sector is seldom. Peacock et al. (1995) explore the economic feasibility of a New Jersey fresh tomato packing facility. Elkjaer (2000) recognizes Stochastic Budget Simulation (SBS) as a simple tool to estimate the overall farm costs that can avoid the statistical dependencies between variables. Clancy et al. (2012) used nontraditional budgeting to estimate returns from willow and miscanthus in Ireland. Similarly, Awondo, Fonsah, and Gray (2017) consider price and yield as risk-associated variables and provide the probability distribution of net present value and break-even year from producing muscadine grapes in Georgia.

The stochastic budget for blueberry production in Georgia has not been developed yet, although the University of Georgia Cooperative Extension has developed a traditional budget for southern highbush blueberry for the years 2004, 2018, and, recently, 2019. However, risk-rated budget analysis of southern highbush blueberries in Fonsah et al. (2007) and rabbiteye blueberries in Fonsah et al. (2008) and Fonsah et al. (2011) incorporated risk associated with blueberry production in Georgia to some extent. Fonsah et al. (2007) showed blueberry growers could earn profit with a chance of 92% from southern highbush blueberries. Similarly, Fonsah et al. (2011) depicted an 86% chance of earning profit from rabbiteye blueberry. These above-mentioned papers used sensitivity analysis to evaluate the effect of price and yield fluctuation incorporating risk in blueberry production. Net returns were calculated as what-if prices and yields, which to some extent allows us to evaluate net returns in a few different price-yield scenarios. However, it does not allow us to project the whole range of net returns.

Therefore, sensitivity analysis, although a common approach to cope with the problem of agricultural production risk, can consider only one component as a variable at a time (Lien, 2003). Hence, a more sophisticated way of addressing uncertain variables is defining the distribution of the variables and interpreting them using the aprobabilistic approach.

Methods

Deterministic Budget

We considered two components—costs and returns—based on an acre of fresh market southern highbush blueberries in Georgia. The budget was developed for a production system that uses a drip irrigation system and plant density of 1,210 per acres and planted distance of 12 ft within rows and 3 ft between rows. Input recommendations and prices were obtained from the University of Georgia (UGA) Extension team and agricultural vendors. Secondary data were also obtained from the UGA Agricultural Economics website and the U.S. Department of Agriculture's Economic Research Service. The total cost of production was captured by estimating the fixed and variable (pre-harvest, and post-harvest and marketing) costs (Kunwar et al., 2019). We used standardized practices recommended by the AAEA Task Force on Commodity Costs and Returns to estimate machinery and equipment costs. We assumed new machinery and equipment costs using 2020 prices and based our calculations on 10 acres since full efficiency is not obtained if used under 4 acres (Fonsah et al., 2007). However, the costs later are adjusted to 1 acre to harmonize with other costs. We estimated the price per pound and the yield per acre based on the multiple meetings and focus group discussions with growers, county agents, and economists. We used 15 years of production period for estimating costs and returns, although blueberries can be harvested from an orchard for more than 15 years with the adoption of good agricultural practices (GAP).

To appraise the investment in blueberry production in Georgia, we calculated the net present value (NPV) of cash flows of 15 years. NPVs were calculated on two discount rates of 2% and 5% to capture the variability in the personal discount rate of growers.

Stochastic Budget

Unlike the deterministic budget, we described the yield and price of blueberries as random components, assessed and defined the distribution of yields and prices, and used simulations to model the returns from the blueberry production system. The Monte Carlo simulation was adopted assuming both the price and the yield follow the triangular distribution. We used the single-point estimates for production costs that were estimated from the deterministic budget developed earlier. Finally, NPVs were calculated from the total costs and the simulated yields and prices, and a probabilistic approach was used to evaluate NPVs.

Results

Deterministic Budget

The total variable costs in the first three establishment years were estimated at $6,947.26/acre, $4,833.65/acre, and $9,379/acre, respectively. For each of the full productive years, the total variable costs were estimated at $15,544.24/acre. The reason for the observed decrease in the total variable costs in the 2nd year from the 1st year is that there is no cost for land preparation, planting, and planting materials. Similarly, the total fixed costs estimated for years 1, 2, 3 and 4 -15 were $2,849.46/acre, $2,026.11/acre, 2,022.92/acre, and $2,054.23/acre, respectively which included a fixed machinery cost of $1,521.3/acre every year.

Table 1 shows the cash flows for the 15-year production period and the calculated NPVs at 2% and 5% discount rates. The investment in blueberry production begins to yield positive returns after the third year and covers the original cost of the investment in the ninth year. The net present value at both discount rates was positive, making the investment attractive for blueberry growers.

Table 1. Cash Flows and NPVs of Blueberry Production in Georgia, 2020

Year	Yield	Price	Return	Variable Cost	Return over Variable Cost	Total Cost	Return over Total Cost (Net Cash Flow)
1	0	3	0	6,947.26	-6,947.26	9,796.72	-9,796.72
2	1,615	3	4,845	4,833.65	11.35	6,859.77	-2,014.77
3	3,800	3	11,400	9,379.00	2,021.00	11,401.92	-1.92
4	6,650	3	19,950	15,544.24	4,405.76	17,598.47	2351.53
5	6,650	3	19,950	15,544.24	4,405.76	17,598.47	2,351.53
6	6,650	3	19,950	15,544.24	4,405.76	17,598.47	2,351.53
7	6,650	3	19,950	15,544.24	4,405.76	17,598.47	2,351.53
8	6,650	3	19,950	15,544.24	4,405.76	17,598.47	2,351.53
9	6,650	3	19,950	15,544.24	4,405.76	17,598.47	2,351.53
10	6,650	3	19,950	15,544.24	4,405.76	17,598.47	2,351.53
11	6,650	3	19,950	15,544.24	4,405.76	17,598.47	2,351.53
12	6,650	3	19,950	15,544.24	4,405.76	17,598.47	2,351.53
13	6,650	3	19,950	15,544.24	4,405.76	17,598.47	2,351.53
14	6,650	3	19,950	15,544.24	4,405.76	17,598.47	2,351.53
15	6,650	3	19,950	15,544.24	4,405.76	17,598.47	2,351.53

Note: NPV at discount rate of 2% (NPV@2%) = 12,128.70
NPV at discount rate of 5% (NPV@5%) = 7,187.17
Measurement Note:
Yield in pounds per acre.
Price in dollars per pound.
Return, variable cost, and total cost in dollars per acre.

Stochastic Budget

Figures 1 and 2 give the probability density function and cumulative distribution function of NPV at two discount rates. The probability of getting positive NPV was very low— 30% and 24% at 2% and 5% discount rates, respectively. The expected NPV was -$8,157/acre at a 2% discount rate and -$9,174/acre at a 5% discount rate. As the chances of a positive NPV are below 50%, the investment in blueberry production does not seem favorable in Georgia.

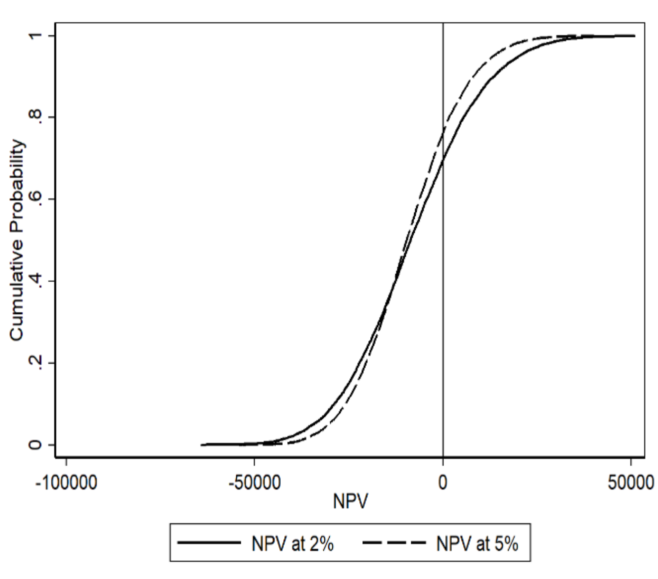

Figure 1. CDF of NPV of Blueberry Production in Georgia

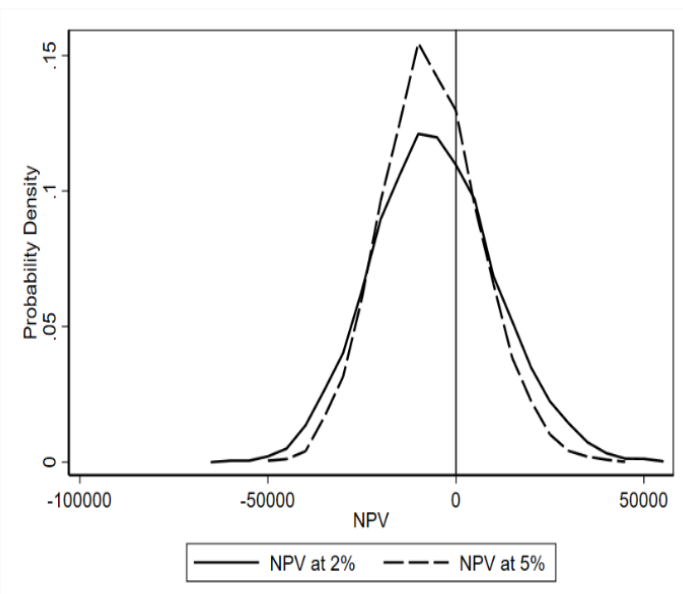

Figure 2. PDF of NPV of Blueberry Production in Georgia

The expected NPV in the deterministic budget is 248.70% more than the expected NPV in the stochastic budget at a 2% discount rate and 178.34% at a 5% discount rate. This shows that the result from the traditional budget is unrealistic and unjustifiably optimistic. The findings here are in line with Awondo, Fonsah, and Gray (2017), which depicted that the chance of getting a positive NPV from the non-stochastic budget is three to four times greater than that from the stochastic budget.

Conclusion

The findings of our research show that blueberry production in Georgia is not as attractive as portrayed by the deterministic budget. Since the components of the production are random, the output variable, such as the NPV in our model, with 100% certainty does not account for the real-world agricultural production process. Thus, the probabilistic approach along with the deterministic approach helps growers to analyze and compare their profitable scenarios and boost confidence in investing in agricultural business. With direct implications for growers, this study can also be useful in the formulation and implementation of agricultural policies. This study does not consider costs (input prices) as stochastic variables. The consideration of input prices as random variables will improve the findings of the study; thus, this consideration could be a possible extension of our work.

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