WHOLE FARM ANALYSIS OF CONTINUOUS COTTON VERSUS A COTTON/CORN ROTATION: AN INTRODUCTION

D. W. Parvin
Professor
MSU
Starkville, MS
F. T. Cooke
Economist
MAFES
Stoneville, MS

Abstract

The cotton/corn rotation is hypothesized to lower equipment fixed cost per acre. This paper introduces new research activity in the area of equipment fixed cost by contrasting partial and whole farm analysis. Cotton harvest and subsoiling are employed as an example.

Introduction

Agricultural equipment, especially tractors and harvesting units, is expensive. Their annual fixed cost is large. For example, the annual fixed cost associated with the 190 horsepower tractor in Table 1 is $11,520 (19.20 x 600) and the annual fixed cost associated with the 4-row picker is $29,750 (148.75 x 200).

Simply stated, the question is: "Are there possible savings in equipment fixed cost, which would reallocate a given field from crop A to crop B?", (i.e. alter the crop mix and improve net revenue or maintain expected net revenue while reducing risk). The authors and others have recently initiated a research project designed to investigate possible savings and their implications.

In general, studies designed to investigate the appropriate amount of equipment on a specific farm require "whole farm" analysis. Typically, the research team develops models which allow alternative crops to share or compete for available power units (and/or tools, i.e. towed equipment) or to determine the minimum number of power units and/or tools of each type. The models may be numerical in nature and employ optimizing algorithms or they may be non-optimizing simulations. However, all tend to be "driven" by days (hours) suitable for fieldwork per time period (usually intervals of one or two weeks). Hence, some of the models are quite complex. However, fall tillage work in cotton, typically completed after cotton harvest, is a rather straightforward example and is the focus of this report. The objective of this preliminary report is to acquaint graduate students, administrators, colleagues and growers (especially the 15-20 that will participate in this project) with the general scope of the research.

Data

The technical parameters employed in this report are given in Table 1. The tractor selected is large enough to handle the three-shank subsoiler with a performance rate of 0.188 hours per acre and small enough to be employed in the crop with operations like cultivation. The 4-row picker has a performance rate of 0.181. This performance rate implies a full compliment of support equipment - specifically boll buggies and module builders (Cooke, Parvin, and Spurlock). The picker is assumed to scrap (harvest twice) 30 percent of the acreage.

Earliness in cotton production and improvements in cotton pickers and seed cotton handling equipment have dramatically changed the rate at which seed cotton can be removed from the field. In 1985 (Parvin, Smith, and Cooke), 2-row cotton pickers were assumed to handle 220 acres with a 60 percent scrap. By 1990 (Parvin, 1990a), the standard cotton picker was still a 2-row, but acres per year had increased to 302 with a 50 percent scrap. Currently the standard cotton picker is 4-row and the average percent scraped is down to 30 percent. The performance rates and annual hours of use employed in this study translate to approximately 850 acres per picker for first pick and 250 acres for scrapping. Specifically the average numbers are 882.61 acres per 4-row picker per year with 264.78 acres scrapped. These estimates require 159.75 hours for first pick and 40.25 hours for scrapping.

Earlier harvest initiation combined with faster performance rates allow the possibility of completing additional fall tillage (specifically subsoiling, in this example) with the possibility of reducing the number of tractors required to subsoil.

Procedure

Days suitable for field work per week and the hours suitable for field work per day are reported in Table 2. Based on the performance rates provided in Table 1, the acres harvested per week, first pick and scrap, and the acres subsoiled per week are given in the last three columns. The effect of earliness is calculated by initiating harvest on four separate dates, calculating the number of days to complete harvest and applying the amount of time saved to subsoiling. Additionally, earliness provides the opportunity to reduce the number of pickers.

Results/Continuous Cotton

The results are summarized in Table 3. When harvest is initiated on 10/02, the hours necessary to complete first pick requires 33 calendar days, ending on 11/04 and 27 days for scrapping ending on 11/30. The 10/02 harvest initiation

Reprinted from the *Proceedings of the Beltwide Cotton Conference*
Volume 1:343-345 (1999)
National Cotton Council, Memphis TN

date requires a total of 60 calendar days to complete. If harvest can be initiated on 9/18, first pick is completed on 10/15 (not 11/04), and scrapping is completed on 10/23 (not 11/30). Therefore, although the information summarized in columns one and three of Table 3 requires exactly the same number of hours to complete, the harvest initiated two weeks earlier requires only 37 calendar days relative to 60 days, a savings of 23 days in the length of harvest and a savings of 37 days in the difference in harvest ending dates. The hours saved due to starting harvest on 9/25 rather than 10/02 are 41.90. Specifically this means that between 11/04, the ending date for one week earlier, and 11/30, there are 41.90 hours available for fieldwork.

Earliness has become a standard practice in commercial cotton. Researchers are almost as likely to report treatment effects on earliness as on yield (Triplett et al., 1996). The standard harvest initiation date in the central Delta area of Mississippi, is about 9/25. If maturity can be enhanced 14 days (to 9/11), 129.18 - 41.90 or 87.28 hours will be saved per picker unit (882.61 acres). Therefore, if the grower has 2,023 (200 ÷ 87.28 x 882.61) acres of cotton and can advance harvest initiation date from 9/25 to 9/11, he (or she) can save one picker (and still complete harvest on 11/30).

The time saved (87.28 hours) could be applied to subsoiling. A 190 HP tractor will subsoil 531.91 acres per 100 hours or 464 acres in the time saved. The reader is cautioned that the time saved is associated with one picker unit or 882.61 acres of cotton. Partial analysis indicates that if the grower can advance harvest initiation date from 9/25 to 9/11 and has, 1,011 (100 ÷ 87.28 x 882.61) acres of cotton, he can save one subsoiler (tool). And, if the farm has many tractors, and if subsoiling requires more tractors than any other operation or time period, he can save one tractor. Whole farm analysis would provide that additional information.

Results/Corn Rotation

The authors have been providing tables similar to Table 3 since 1985 (Cooke, Parvin, and Spurlock; Parvin, 1990a, b; Parvin, 1991; Parvin and Cooke; Parvin, Smith and Cooke) and discussing savings based on partial analysis indicating fewer pickers and/or more acres per picker per year. The difficulty with the authors' set of days fit for fieldwork is that they are only for nontillage operations and were estimated only for the harvest period. A recent Louisiana report (Zapata et al.) provides estimates of days (hours) suitable for fieldwork for other periods (20 periods, basically 14 days in length, covering the entire year) and includes both tillage and nontillage operations.

In the central Delta area of Mississippi, enough corn should be harvested to begin fall tillage (subsoiling in this example) by mid-August. The 1997 Louisiana study reports 103.29 (9.39 days x 11 hour/day) hours available for tillage for their 14-day period in late August (8/16-8/29). This is more hours than our average growers are obtaining per subsoiler per year. And, it occurs at a time when the cotton is "laid by" and cotton harvest has not started. To estimate the number of subsoilers required, the grower simply establishes a subsoiling completion date. If he selects 9/20 (approximately 100 hours beyond the Louisiana ending date of 9/28), the number of subsoilers could be halved (assumes 1:1 rotation). Whole farm analysis will indicate the reduction in the number of tractors. Certainly, a cotton/corn rotation may result in fewer tractors than continuous cotton since the advantages of earliness associated with continuous cotton apply to the cotton acreage in the rotation.

Data Limitations

Calculations of the type presented in this report are subject to additional constraints. For example, the number of tractors to be reduced based solely on additional subsoiling capacity. The grower must check other critical time periods such as planting and cultivation to be sure that the reduced number of tractors is sufficient to complete those operations in a timely fashion.

From a practical standpoint, savings in equipment fixed cost will require that a second crop be grown on soils suitable for cotton rotation such that the second crop can be harvested in time to allow for fall tillage operations on that block of land prior to and during the harvest of cotton. There is also the possibility that other operations such as planting and cultivation of the various crops may be staggered in a manner that provides an opportunity to reduce the number of tractors required. Whole farm analysis will consider most of the additional constraints. The expected research tool to be developed will be a linear programming model structured around the 20 Louisiana time periods. Before the model will be useful to cotton producers, considerable agronomic and associated research related to the most profitable practices in a cotton/corn rotation will be required.

References

Bolton, Bill, J. B. Penn, F. T. Cooke, and A. M. Heagler. 1968. Days Suitable For Fieldwork, Mississippi River Delta Cotton Area. D.A.E. Res. Report No. 384, Louisiana State University.

Cooke, F. T., D. W. Parvin and S. R. Spurlock. 1991. The Cost of Cotton Harvesting Systems In The Mississippi Delta. MAFES Bulletin 972, Mississippi State University.

Costs And Returns, 1990, Cotton, Mississippi Delta. 1989. Agricultural Economics Report 34, Mississippi State University.

Delta 1998 Planning Budgets. 1997. Agricultural Economics Report 90, Mississippi State University.

Estimated Costs And Returns, 1985, Cotton, Mississippi. 1985. Publication 1483, Mississippi State University.

Parvin, D. W. 1990a. The Importance of Harvest Initiation Date. Procedures of Beltwide Cotton Production Research Conference, National Cotton Council of America, Memphis, TN, p. 471-474.

Parvin, D.W. 1990b. The Weight Loss Associated With Defoliated Cotton and Its Implications. Proceedings of Beltwide Cotton Production Research Conference, National Cotton Council of America, Memphis, TN, p.469-471.

Parvin, D. W. 1991. The Economics Of Earliness: Stoneville, Mississippi and Moree, New South Wales. Proceedings of Beltwide Cotton Production Research Conference, National Cotton Council of America, Memphis, TN, p. 392-394.

Parvin, D.W. and F. T. Cooke. 1990. The Mathematics of Cotton Harvest. Proceedings of Beltwide Cotton Production Research Conference, National Cotton Council of America, Memphis, TN, p. 119-121.

Parvin, D. W., J. W. Smith and F. T. Cooke. 1985. The Economics of Cotton Harvesting in the Midsouth as it Relates to Shorter Season Production Systems. Agricultural Economics Staff Paper No. 74, Mississippi State University.

Triplett, G. B., S. M. Dabney and J. H. Siefker. 1996. Tillage Systems for Cotton on Silty Upland Soils. Agronomy Journal, Vol. 88, No. 4, July-August, p. 507-512.

Zapata, H., Giesler, G., Bolton, B., J. M. Salassi. 1997. Louisiana Weather Impact on field Days. D.A.E. Research Report 707, Louisiana State University.

Table 1. Performance rate, annual use, purchase price, and direct and fixed cost per hour and per acre, selected equipment, Mississippi, 1998.

Item Name	Size	Perf Rate	Annual Use	Purchase Price	Direct	Cost-	Fixed	Cost-
		hrs/ac	hours	dollars	$/hr	$/ac	$hr	$/ac
Tractor	190 hp		600	88,000	13.72		19.20	
Picker-1st	4-row	0.181	200	188,000	82.08	14.86	148.75	26.92
Picker-scrap	4-row	0.152	200	188,000	82.08	12.48	148.75	22.61
Subsoiler	3 shank	0.188	100	3,110	2.07	0.39	3.94	0.74

Source: Delta 1998 Planning Budgets, Tables 1 and 2, p. 110 and 113.

Table 2. Days and hours suitable for fieldwork, cotton harvesters and subsoiling acres, selected weeks, Mississippi.

Week	Days/ Week	Hours/ Day	Hours/ Week	1st Pick	2nd Pick	Subsoil
				---------Acres/Week-----------		
08/28-09/03	4.66	9.11	42.45	234.53	279.28	225.80
09/04-09/10	4.77	9.02	43.03	237.73	283.09	228.88
09/11-09/17	4.88	8.97	43.77	241.82	287.96	232.82
09/18-09/24	4.90	8.88	43.51	240.39	286.25	231.44
09/25-10/01	4.74	8.84	41.90	231.49	275.66	222.87
10/02-10/08	4.72	8.75	41.30	228.18	271.71	219.68
10/09-10/15	4.39	8.66	38.02	210.06	250.13	202.23
10/16-10/22	4.04	8.55	34.54	190.83	227.24	183.72
10/23-10/29	3.59	8.39	30.12	166.41	198.16	160.21
10/30-11/05	2.34	7.91	18.51	102.27	121.78	98.46
11/06-11/12	1.96	7.51	14.72	81.33	96.84	78.30
11/13-11/19	1.44	6.97	10.04	55.47	66.05	53.40
11/20-11/26	1.35	6.60	8.91	49.23	58.62	47.39
11/27-12/03	1.30	6.37	8.28	45.75	54.47	44.04
12/04-12/10	1.28	6.21	7.95	43.92	52.30	42.29
12/11-12/17	1.28	6.10	7.81	43.15	51.38	41.54

Source: [Bolton et al., Parvin and Cooke]

Table 3. Summary data on length of harvest for selected harvest initiation dates.

ITEM	EARLY OCTOBER	ONE WEEK EARLY	TWO WEEKS EARLY	THREE WEEKS EARLY
DATES				
Initiate harvest	10/02	09/25	09/18	09/11
End first pick	11/04	10/23	10/15	10/07
End scrap	11/30	11/04	10/23	10/14
DAYS				
First Pick	33	29	28	27
Scrap	27	13	9	8
Total	60	42	37	35
Difference in length of harvest	-	18	23	25
Difference in ending date	-	25	37	46
Hours Saved	-	41.90	85.41	129.18