Computer use in Tulare County agriculture

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About a fourth of the farmers surveyed used computers, more often for general ledger and similar applications than as crop management and production-decision aids

The availability of low-cost microcomputers permits widespread application of computer technology by farmers and ranchers to bookkeeping, planning capital expenditures, pest control, and many other tasks. Many groups, including University of California and California State University researchers and teachers, organizations such as the Farm Bureau, software developers, and farmers themselves, have taken an active interest in computer use in agriculture.

Despite this interest, little analysis of computer ownership and use patterns in agriculture has occurred. Understanding the factors that influence farm-level computer use will assist in the development of successful computer-oriented programs by identifying the needs of various clientele groups. We therefore conducted a study to determine the key characteristics of farmers and farm businesses that influence the use of computers and the various types of application software.

The study included a mail survey of 1,000 Tulare County farmers between March and June 1986. Usable data were collected from 449 individuals—a 45 percent response. Average age, education level, and farm ownership patterns of the respondents were very similar to those reported in the 1982 Tulare County Agricultural Census, suggesting that the sample is representative of Tulare County farmers. The proportion of survey respondents owning a computer, however, is higher than many people involved with agricultural computer use believe is the case in the actual population.

The types of application software considered in this study were general ledger and cost accounting, payroll, inventory, crop and livestock management, production-decision aids (herd improvement, feed formulation, pest control, and irrigation scheduling packages), spreadsheet, and database management.

We used the data from the survey to determine by statistical analysis how certain variables affect the likelihood of computer ownership and the use of various types of application software. The variables included farm size (measured by gross sales), farm products produced, the number of enterprises that made up the farming operation, the education level of the farm operator, the age of the operator, and the type (if any) of farm-related businesses owned.

Computer use patterns

Eight of the farmers who indicated that they owned a computer did not respond to the questions about application use. Of the responding producers, 25.6 percent used a computer in their farming operations (table 1). The use of various types of applications varied considerably. The most likely applications were general ledger and cost accounting (75.7 percent of computer owners) and payroll (67.3 percent), while the least commonly used were crop/livestock management programs (9.4 percent) and production-decision aids (16.8 percent).

The computer ownership analysis indicates that: (1) the likelihood of computer ownership increases as farm size increases, but at a decreasing rate; (2) the production of different farm products does not have a statistically significant effect on the likelihood of computer ownership; (3) the likelihood of computer ownership first increases with operator age (up to the 36- to 40-year-old group) and then begins to decrease with age (with farmers over the age of 70 particularly unlikely to be computer owners); (4) farm operators with either a Bachelor's or graduate degree are much more likely to use a computer than those with less than a Bachelor's degree; (5) farm operators who own either a sales-related business (packing shed or other sales) or a pest control service are more likely to own a computer than are operators who do not own a business, while owners of most service-related businesses (farm management consultants or other service) are less likely to own a computer than are operators who do not own a business (table 2).

We used the estimated probability model that the analysis was based on to estimate the probability of computer ownership by 41- to 50-year-old Tulare County farm operators. It was assumed that the farm operator owned no farm-related business. The probability of computer ownership was compared under different mixes of farm products, farm sizes, and operator education levels. The assumed mix of farm products corresponds to common product mixes found on Tulare County farms. The estimated probabilities can be interpreted as the estimated percentage of farm operators within that subgroup who own a computer.

There is a larger disparity in the level of computer ownership across farm size and operator education levels than across farm products produced. A strong effect of both education level and farm size on the choice of whether or not to own a computer is apparent (table 3).

TABLE 1. Computer use, Tulare County, 1986

Subject	Yes	No	Percentage of "yes" responses
			%
Own a computer	115	334	25.6
Owners use computer for*:			
Accounting	81	26	75.7
Spreadsheet	63	44	58.9
Payroll	72	35	67.3
Inventory control	23	84	21.5
Database management	33	74	30.1
Production-decision aids	18	89	16.8
Crop/livestock management	10	97	9.4

NOTE: Responses are from 449 farmers from a sample of 1,000 of the approximately 5,570 Tulare County, California, farmers.
* Includes farmers who owned a computer used for farming purposes, and who completed the application questions. Eight computer owners did not complete the application questions and were omitted.

Application use patterns

The statistical analyses of software application use patterns were similar to the analysis performed to assess computer ownership patterns. The results indicate that: (1) farm size increases (at a decreasing rate) the use of most types of computer applications while decreasing the likelihood of spreadsheet and database management use; (2) the production of different farm products has significant effects on application use, with crop operators more likely to use business-

transaction cost-reducing applications (accounting, payroll, and inventory) and livestock producers more likely to use management decision-making applications (production-decision aids and crop/livestock management programs); (3) neither age nor education level has a discernible pattern of influence on farmers' application use; (4) owners of farm-related businesses appear to introduce into their agricultural operations applications also used in their other business operations, with owners of sales-related businesses more likely to use certain types of business-transaction cost-reducing applications and pest control advisors more likely to use production-decision aids (that include pest management applications); and (5) increasing years of computer ownership increase the likelihood of using most applications but decrease the relative likelihood of using general ledger and payroll applications.

Table 4, presenting probability estimates of the use of spreadsheet, production-decision aids, and general-ledger and cost-accounting applications by 41- to 50-year-old Tulare County farm operators, is based on the same assumptions and statistical models used for table 3. The analysis indicates that the probability of spreadsheet use is roughly comparable for all but the largest farming operations. However, the probability of spreadsheet use is much higher (frequently over four times) for college-educated farm operators than for those with a high school education. The probability of spreadsheet use is also slightly higher for certain types of producers (such as those who grow tree crops)

TABLE 2. Summary of the variables used in the analysis

Variable	Owners	Non-owners	Ratio of owners/nonown.
Number of respondents	115	334	0.34
GROUP VARIABLES			
Farm products*:			
Field crops	24	80	0.30
Vegetable crops	6	14	0.43
Tree fruits & nuts	102	266	0.38
Grapes	41	79	0.52
Nursery	8	11	0.73
Dairy	13	28	0.46
Beef	4	17	0.24
Other livestock†	2	15	0.13
Age group:			
Under 31	6	12	0.50
31 - 35	15	22	0.68
36 - 40	23	23	1.00
41 - 50	33	57	0.58
51 - 60	21	96	0.22
61 - 70	15	85	0.18
Over 70	2	39	0.05
Education level:			
Elementary & high school	12	94	0.13
Some college	12	77	0.16
Junior college	5	44	0.11
Bachelor's degree	65	90	0.72
Graduate degree	21	29	0.72
Farm-related business:			
Packing shed	26	25	1.04
Other sales‡	13	10	1.30
Other services§	8	30	0.27
Farm mgt. consultants	7	9	0.78
Pest control advisors	5	5	1.00
None	71	288	0.25
CONTINUOUS VARIABLES			
Farm income:			
Average	1,509,547	374,989	
Minimum	4,604	552	
Maximum	16,530,111	6,757,977	
Enterprises:			
Average	1.6783	1.5419	
Minimum	1	1	
Maximum	4	4	

* Figures in this category will not add up to the total, since many farms produce more than one farm product.
† Primarily hogs, poultry, and horses.
‡ Includes sellers of seeds, fertilizer, or other material inputs and those who have a farm product marketing business.
§ Includes harvesting and other custom work, nut hullers and dehydrators, and equipment services.

TABLE 3. Estimated probability of computer ownership for a 41- to 50-year-old farm operator with no farm-related business

Gross revenue	Trees	Grapes	Field crops	Trees & grapes	Dairy & field crops	Trees & field crops
$						
High school education:						
100,000	0.13	0.11	0.08	0.15	0.07	0.11
500,000	0.18	0.15	0.11	0.21	0.10	0.16
1,000,000	0.25	0.22	0.16	0.29	0.14	0.22
4,000,000	0.73	0.70	0.62	0.77	0.58	0.71
College education:						
100,000	0.35	0.32	0.25	0.40	0.21	0.32
500,000	0.44	0.40	0.32	0.49	0.28	0.40
1,000,000	0.54	0.50	0.42	0.59	0.37	0.51
4,000,000	0.91	0.90	0.86	0.93	0.83	0.90

TABLE 4. Estimated probability of spreadsheet, accounting, and production-decision aid uses for a 41- to 50-year-old farmer with no farm-related business

Gross revenue	Trees	Grapes	Field crops	Trees & grapes	Dairy & field crops	Trees & field crops
$						
			SPREADSHEET USE			
High school education:						
100,000	0.07	0.05	0.04	0.11	0.04	0.09
500,000	0.08	0.05	0.05	0.12	0.04	0.10
1,000,000	0.08	0.05	0.05	0.13	0.04	0.11
4,000,000	0.02	0.01	0.02	0.04	0.01	0.05
College education:						
100,000	0.28	0.23	0.19	0.35	0.16	0.29
500,000	0.31	0.24	0.21	0.39	0.18	0.34
1,000,000	0.31	0.24	0.22	0.42	0.20	0.38
4,000,000	0.07	0.05	0.06	0.13	0.06	0.15
			ACCOUNTING USE			
High school education:						
100,000	0.06	0.03	0.03	0.12	0.00	0.09
500,000	0.12	0.08	0.06	0.19	0.01	0.15
1,000,000	0.22	0.17	0.13	0.28	0.04	0.22
4,000,000	0.73	0.70	0.62	0.77	0.57	0.71
College education:						
100,000	0.14	0.08	0.07	0.31	0.01	0.26
500,000	0.28	0.19	0.16	0.44	0.03	0.37
1,000,000	0.46	0.37	0.32	0.57	0.09	0.50
4,000,000	0.91	0.89	0.86	0.93	0.82	0.90
			PRODUCTION DECISION AID USE			
High school education:						
100,000	0.004	0.000	0.001	0.002	0.023	0.008
500,000	0.007	0.000	0.002	0.002	0.037	0.012
1,000,000	0.012	0.001	0.004	0.004	0.061	0.021
4,000,000	0.099	0.007	0.044	0.034	0.408	0.174
College education:						
100,000	0.031	0.002	0.011	0.011	0.126	0.054
500,000	0.045	0.003	0.017	0.016	0.178	0.079
1,000,000	0.068	0.005	0.027	0.024	0.256	0.118
4,000,000	0.280	0.027	0.154	0.108	0.727	0.434

The probabilities indicate that use of accounting applications is more common among large farms and perennial-crop producers. Accounting use is less biased toward highly educated farmers than is use of spreadsheet and production-decision aids.

The probability of using production-decision aids is higher for large farms, more educated farm operators, and dairy farmers. The results also indicate that the probability of using a production-decision application is quite low for non-livestock farm operations. One reason for this finding is the greater availability of livestock-oriented production-decision aids, such as herd improvement and feed formulation programs. Crop-oriented production-decision aids are not as widely available; many depend on the use of crop-simulation models, which are for the most part still in the early development stage or do not even exist for some crops. With the development and dissemination of crop production-decision aids by the University, the discrepancy in the use of this type of application between crop and livestock producers is likely to diminish. Our results suggest, however, that the likely users of production-decision aids are well-educated operators running large farms.

Perceived benefits

Several of the questions included in the questionnaire were intended to determine farmers' perceived benefits from computer use. We report responses to two of these questions in table 5. Farmers were asked to indicate their agreement or disagreement with the statements: "Computer use would lower my labor and other costs" and "Computer use would improve my production decisions."

Owners perceived computer use to be more beneficial than nonowners did, based on the larger number of owners who either agreed or strongly agreed with the first and second statements: 72.5 percent of the owners vs. 27 percent of the nonowners regarding the first question, and 80.2 vs. 39.2 percent on the second. Furthermore, a large percentage of nonowners (33.7 and 30.2 percent for each question) did not know if computer use would save labor and other costs or improve production decisions. This suggests that nonowners may want additional information on the potential costs and benefits of using a computer in their farming operations.

Responses to the two statements indicate that, among computer owners, the perceived benefits of computer use are greater the higher the income and education level. Farmers with less than $100,000 in gross annual sales and a high school education or below perceive the lowest benefits from computer use. Those with sales of $100,000 to $500,000 appear to believe that computer use is less likely to save on labor and other costs, compared with the perceptions of farmers with over $500,000 in annual gross sales.

Conclusions

The results of our survey show a trend in the patterns of adopting computer technology toward large farms and well-educated farm operators. These results are not surprising in light of the higher level of perceived benefits of computer use among these types of computer owners compared with owners who have lower education and farm income levels. It also appears that many farmers who do not own a computer are unaware of the potential costs and benefits associated with computer use. These two findings suggest that introductory computer education outreach programs may need to be targeted toward small farms and less-educated farmers, while more advanced computer-oriented programs should be targeted toward large farms and well-educated farm operators.

Another important finding is that farmers make much greater use of transaction-processing applications, such as general ledger and cost accounting, payroll, and inventory, than of decision-support applications, such as crop and livestock management, and production-decision aids. Furthermore, livestock producers are much more likely to use production-decision aids than are crop producers, possibly because of the comparative lack of such applications for crop producers. This finding points out the need for research in the development of crop simulation models, which are required for many types of crop-oriented production-decision aids.

TABLE 5. Agreement with statements relating to the benefits of computer use for Tulare County farmers

Category	Respondents*	Agree	Strongly agree	Disagree	Strongly disagree	Do not know
	n	%				
COMPUTER USE SAVES ON LABOR AND OTHER COSTS						
Computer ownership:						
Owners	109	27.5	45.0	17.4	0.9	9.2
Nonowners	300	7.0	20.0	30.3	9.0	33.7
Farm income level†:						
Under $100,000	14	28.6	14.2	28.6	0.0	28.6
$100,000 - $500,000	31	19.4	48.4	22.6	0.0	9.6
$500,000 - $1 million	25	24.0	60.0	8.0	0.0	8.0
$1 - $4 million	29	31.0	51.7	13.8	3.5	0.0
Over $4 million	10	50.0	20.0	20.0	0.0	10.0
Farmer education level†:						
High school & below	11	27.3	18.2	45.5	0.0	9.0
Junior & college	16	37.5	37.5	6.2	0.0	18.8
Bachelor's degree	62	32.3	50.0	9.7	1.5	6.5
Graduate degree	20	5.0	50.0	35.0	0.0	10.0
COMPUTER USE IMPROVES PRODUCTION DECISION-MAKING						
Computer ownership:						
Owners	111	26.1	54.1	7.2	0.9	11.7
Nonowners	288	5.9	33.3	24.3	6.3	30.2
Farm income level†:						
Under $100,000	14	28.6	35.7	14.3	0.0	21.4
$100,000 - $500,000	30	16.6	66.7	6.7	0.0	10.0
$500,000 - $1 million	25	20.0	60.0	4.0	0.0	16.0
$1 - $4 million	32	31.3	50.0	6.2	3.1	9.4
Over $4 million	10	50.0	40.0	10.0	0.0	0.0
Farmer education level†:						
High school & below	10	20.0	30.0	20.0	0.0	30.0
Junior & college	17	35.3	52.9	5.9	0.0	5.9
Bachelor's degree	63	28.6	49.2	6.3	1.6	14.3
Graduate degree	21	14.3	81.0	4.7	0.0	0.0

*Indicates the number of farmers in each category who responded to the question.
†Reported figures for the farm income level, and farmer education level categories are for computer owners.

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