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Costs of Adopting Good Agricultural Practices (GAPs) to Ensure Food Safety in Fresh Strawberries

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In a recent survey of retail produce buyers in *Progressive Grocer*, food safety was ranked as the third most important challenge facing the retail industry. In fact, buyers ranked food safety as more important than attracting shoppers to produce or the quality of the product being sold (Heller, 2002). The National Good Agricultural Practices (GAPs) program was developed in 1999 to educate growers and first handlers of fresh produce about methods to reduce the potential for microbial contamination. GAPs address on-farm food safety issues through a set of practices developed by USDA that a grower may voluntarily adopt. The focus of this paper is how the adoption of GAPs affects farm-level costs of production across different firm sizes. The paper looks at the adoption of GAPs by fresh strawberry growers in the U.S. and presents some of the additional costs that a typical fresh strawberry grower might incur with GAPs adoption. The costs developed here are meant to serve as a starting point for growers thinking of adopting GAPs, but curious about the additional costs of adopting these practices.

The U.S. Fresh Strawberry Production System

Fresh strawberry producers in North America can be divided into two distinct groups; very large firms that produce primarily for traditional retail grocery markets and smaller firms that produce for farmers markets, roadside stands, and u-pick operations. On average, large and small fresh strawberry producers are further distinguished by how they grow strawberries, which affects their costs of production and yields. Large growers tend to produce fresh strawberries using an annual plasticulture system, while many small growers use a perennial mulch bed system.

Since 2000, California has supplied more than 85 percent of the total market for fresh strawberries. By 2002, California had nearly 5 times the acreage of Florida, the next largest producing state, and Florida had at least twice as many acres as Oregon, the third largest state in terms of acreage (Table 1). Oregon and Washington rank third and fourth for acreage in the U.S., however, about 95 percent of production from these two states goes to processing (Oregon State Statistical Service, 2001). In this analysis the growers in California and Florida are characterized as large since average farm size in these two states is so much greater than average farm size in the other fresh strawberry producing states.

Table 1. Average size of U.S. strawberry farms, 2002

	Farms	Acres	Average Acres
CA	684	32,183	47
FL	217	6,595	30
OR	328	3,013	9
WA	226	1,953	9
MI	312	1,224	4
NC	279	991	4
NY	488	1,406	3
WI	341	886	3
OH	413	659	2
PA	685	1,264	2

Source: USDA-NASS, Agricultural Census 2002

Estimating the Costs of GAPs Adoption: Costs of Production Without GAPs

To understand the sources and levels of the costs of GAPs adoption, it is important to understand the costs of producing fresh strawberries without GAPs. These costs vary widely by state and by type of production system. Costs in California and Florida are for the annual plasticulture production system, while in the remaining states, excepting North Carolina, costs

are for the perennial mulch bed system. In North Carolina, plasticulture is growing in popularity and the costs and yields shown below in Table 2 below reflect this system (Southern Region Small Fruit Consortium, 2005).

The costs of fresh strawberry production absent any additional food safety practices are helpful for understanding the costs of GAPs adoption. For this paper, cost of production information for fresh strawberries was collected from several state and regional sources. Costs in Table 2 are reported on a per pound basis using average production for each state, and per acre, as typically reported in cost of production estimates.

From Table 2 it is obvious that California leads the country in yield per acre and so, logically, also has low production costs per pound. Florida follows California with less than half as much yield per acre and about two-thirds of the production cost per acre. With the exception of Oregon and Washington, per pound costs of production are higher in states where yields are reduced. Once again, it is important to note that the numbers for Oregon and Washington are heavily influenced by the large amount of processing strawberries sold in these two states.

Table 2. Fresh strawberry yields, production costs, adjusted costs and sources [a]

State or region	Yield (lbs/acre)[b]	Cost /acre ($)	Cost/lb ($)	2004 adjusted	Source	Publication date

				costs/lb($)[c]		
CA-Oxnard Plain	57,000	$31,400	0.55	0.55	Daugovish, et al.	2004
CA-Santa Maria Valley	51,592	$29,053	0.56	0.56	Bendixen, et al.	2004
CA-Central Coast	50,200	$31,846	0.63	0.63	Bolda, et al.	2004
Florida	25,200	$21,187	0.84	0.94	Institute of Food and Agricultural Sciences – UF	2002
North Carolina	15,000	$16,778	1.11	1.24	Fonsah, et al.	2002
Oregon	12,000	$4,828	0.40	0.50	Cross, Sheets, and Strik	1991
Washington	12,000	$4,828	0.40	0.50	Cross, Sheets, and Strik	1991
Pennsylvania	6,400	$6,221	0.97	1.09	Bowling et al.	2002
Michigan	5,300	$4,739	0.89	1.05	NRAES	1998
Wisconsin	5,000	$4,739	0.95	1.12	NRAES	1998
Ohio	7,000	$5,250	0.75	0.88	Ohio State University Extension	1998
New York	3,300	$4,739	1.43	1.69	NRAES	1998

[a] For California, Florida, Ohio, North Carolina, and Pennsylvania publications from the state cooperative extension service were used to calculate costs of production for fresh strawberries. For Oregon and Washington, costs of production were calculated for all strawberries using a budget from the Oregon Cooperative Extension Service, since no such budget exists for Washington and the two states tend to mirror one another in production method and market for their berries. Production costs for Michigan, New York, and Wisconsin were calculated using report NRAES-88 from the Northeast Regional Agricultural Engineering Service (NRAES) which provides budgets for fresh strawberry producers in the Northeast and Midwest of the U.S. as well as for Eastern Canada. Publication dates for all of these sources vary, so, they are included along with the cost of production estimates in Table 2.

[b]Yields per acre for all states, except Michigan, Wisconsin, and New York, are from the cost of production publications. For the remaining three, estimates are from the USDA-NASS Noncitrus Fruits and Nuts Summary for 2003.

[c]Cost of production estimates were adjusted to 2004 dollars using the U.S. Bureau of Labor Statistics' estimates for the producer price index for all commodities.

The Cost of GAPs

GAPs can include any number of steps and practices aimed at reducing microbial contamination of fresh produce at the farm level. In this paper, a group of five GAPs is used to represent what a typical fresh strawberry grower might adopt in the first stage of implementing a food safety management program. The GAPs practices are: provision of toilet and handwashing facilities for pickers in the field and visitors and workers at a u-pick or direct market location, training on hygiene, including direct training and signage, packing shed or cooling pad sanitation and, when appropriate, use of single-use trays, monitoring water used for irrigation, and developing a crisis management plan for the business should a food safety outbreak occur. This list of practices was developed with the help of GAPs expert Betsy Bihn (2004), through discussions with strawberry growers (Jameson, 2002; Kerznar, 2002), and by reviewing private and public third party certification guidelines (Primus, 2004; U.S. Department of Agriculture-Agricultural Marketing Service, 2004). Each of the five GAPs is discussed in detail, and the costs arising from adoption are explained. Since the costs of GAPs adoption vary with grower size, each GAP is discussed with respect to a small grower producing for direct market or u-pick and for a large grower producing for the grocery trade. The costs of all of the GAPs are summarized in Table 3 below and are calculated as total cost and a cost per acre.

Table 3. Total and per acre costs of selected GAPs

	Small u-picks	**Florida**	**California**

Average farm size:	*4.8 acres*		*30 acres*		*47 acres*	
Season length:	1 month		5 months		11 months	
GAP	Total cost	Cost per acre	Total cost	Cost per acre	Total cost	Cost per acre
1. Toilet and handwashing facilities	$220.00	$46.00	$3,375.00	$113.00	$5,288.00*	$113.00
2. Hygiene Training	60.00	12.00	691.00	23.00	1,056.00	22.00
3. Packing shed or cooling pad sanitation and single use trays for u-picks	402.00	83.00	534.00	18.00	1,138.00	24.00
4. Monitoring irrigation water	32.00	7.00	149.00	5.00	149.00	3.00
5. Developing a crisis management plan	670.00	140.00	750.00	25.00	750.00	16.00
Total	$1,384.00	$288.00	$5,499.00	$184.00	$3,093.00	$66.00

* Dropped from total since this cost is already included in the cost of production estimates from California - see GAP #1 below for more information.

Large producers in Florida and California are able to produce strawberries for several months of the year. Florida typically produces for the fresh market five months of the year and California for eleven months of the year (Han, 2003). Small producers generally produce strawberries during only one month or less each year.

1. Provision of toilet and hand washing facilities for employees and u-pick customers

Workers who are ill or carry an infectious disease can contaminate fresh produce and make consumers sick. In the past, several high profile cases of food safety outbreaks were a result of poor worker hygiene on the farm. Visitors to u-picks can also carry infectious diseases and spread them to other visitors and workers by contaminating picking trays and facilities. One important GAP is to have clean, well-stocked toilet and hand washing facilities available for workers and u-pick visitors. Cost estimates for monthly toilet and hand washing station rental are $220 in mid-Michigan for the toilet/washing station and service (Jay's, 2004), and $100 and $125 in the Oxnard Plain of California and the Central Coast region of California, respectively,

for monthly service of a single grower owned toilet for the entire season (Daugovish et al., 2004; Bolda et al., 2004).

For small growers this GAP costs $220 for one month of toilet and hand-washing station rental. For the large growers in this analysis, the expense used is the average of the two numbers from California ($112.50 per month per acre). In the California cost of production budgets, a portable toilet is provided for each acre in production and OSHA standards require one portable toilet for every twenty employees. So, the cost for this GAP is calculated as the portable toilet rate times the average number of acres in production since the expense in the budgets from California is calculated as $112.50 per month for service for an entire season and in the large production regions OSHA requirements would be for one station per acre ($112.50 * 30 acres=$3,375.00 for Florida, and $112.50 * 47 acres= $5,287.50 for California). Since this GAP is already included in the cost of production budgets from CA, it is subtracted from the costs for CA in the final calculation.

2. Hygiene training for workers or u-pick visitors

Direct training on hygiene and the use of signage can help workers and visitors understand some of the major sources of foodborne illness and can decrease the likelihood of contamination. Cost estimates for this GAP are based on estimates for training time. Labor rates and an estimate of the time required to train laborers can be used to arrive at a cost for training. Labor rates vary among the strawberry producing states and between hired labor and operator or management labor. Selected rates collected from sources in strawberry producing states are listed in Table 4.

Average labor rates are calculated for large growers using data from the three main production regions in California. These estimates include a percentage of available fringe benefits, social security taxes, state and federal unemployment, and workers compensation. The

average labor estimates from small growers are taken from a recent study of labor rates in Michigan for tart cherry production (Beedy, 2005). These numbers are used because the cost of production studies for strawberry growers in the small regions do not consistently include, or indicate that they include, fringe benefits or the other additional costs to labor that the California studies do include.

Table 4. Hourly labor rates and sources for strawberry producing regions

State or region	Labor Rates		Source
	Operator	Hired	
California-Oxnard Plain	$12.06	$9.38	Daugovish, O. et al
California-Santa Maria	$12.73	$9.72	Bendixen, W. et al
California-Central Coast	$12.73	$9.72	Bolda, M. et al
Michigan, New York, and Wisconsin	$11.81	$5.98	NRAES
North Carolina	$8.00	$8.00	Fonsah, G. et al
Ohio	$7.50	$6.50	Ohio State University Extension
Pennsylvania	$12.00	$8.00	Demchak, K.
Wage rates for employees of small growers	*$9.78*	*$7.56*	Beedy
Wage rates foremployees of large growers	*$12.51*	*$9.61*	Average of Daugovish, O. et al, Bendixen, W. et al, Bolda, M. et al

For small fresh strawberry producers, the GAP is calculated as training time for two employees plus additional time required for one manager who does the training. The average labor rate for the smaller regions from the table above is $7.56 for labor and $9.78 for management. This GAP cost is $59.58 (($7.56 * 2 laborers * 2 hours) + ($9.78 * 1 manager *3 hours)) for the entire growing season for small growers.

Large growers incur significantly more costs for this GAP than do small growers since they employ many more people. The cost of production budgets from California state that a grower with 80 acres of strawberries employs 90 pickers, a general foreman, a field checker, and a counter to record the amount picked. For this GAP, training is required for the field pickers

and the foreman. The average labor rate for the large strawberry producing regions, from Table 4 above, is $9.61 for laborers and $12.51 for management. For the hourly employees, including the foreman in this case, two hours are budgeted; for management, an extra hour is included to prepare for the annual training. Average farm sizes in California and Florida are 47 and 30 acres, respectively, so in this example the training is for 34 laborers and one manager in Florida, and for 53 workers and 1 manager in California (average acres80/ 90 pickers). The cost of this GAP is $691.01 for Florida (($9.61*2*34) + ($12.51*3)) and $1,056.19 for California (($9.61*2*53) + ($12.51*3)), Table 5.

Table 5. Cost calculations for GAP #2

GAP #2 – Hygiene training for workers/visitors	Labor wage rate	Labor time	Number of laborers	Mgmt wage rate	Mgmt time	Number of mgmt	Total
Small growers	$7.56	2	2	$9.78	3	1	$60.00
Large growers-CA	$9.61	2	53	$12.51	3	1	$1,056.00
Large growers- FL	$9.61	2	34	$12.51	3	1	$691.00

3. Packing shed or cooling pad sanitatio and use of single- use picking trays for u-pickers

This GAP is important for all fresh strawberry growers, but its application varies with the size of grower. Costs to clean the holding shed or cooling pad and exclude animals are the primary expenses of this GAP. Typical costs include weekly cleaning and maintenance of the shed requiring two hours of labor for an average size farm plus cleaning supplies including a sanitizer.

An additional cost associated with this GAP is the cost of single-use trays for picking strawberries. Large growers who sell to retail customers commonly use single use trays and field pack their berries. Small u-pick operations often use reusable containers and the strawberries are then transferred from these containers into single-use trays or bags in a central location. Single-

use trays are favored over reusable containers which can be hard to sanitize and act as a source of contamination when several different customers use the same tray.

For this GAP, small growers incur expenses for cleaning and maintaining the packing shed or farm stand and for purchasing single-use trays for either u-pick or farm stand sales. Using the labor rate for hourly labor from #2 above, the expense for this GAP is calculated as one hour per week plus $2.00 per week for cleaning supplies ($7.56 + $2.00 = $9.56 per week or $38.24 for the season). Costs of the single-use system vary, but one estimate is $95.00 for a case of 600 one pint plastic single-use containers plus $269.00 for 100 master crates used to hold the containers while customers are picking (www.inberry.com, 2004). The cost of the master crates is included here since growers are new adopters of GAPs and so must incur the cost of these crates as first time costs of adoption ($95.00 + $269.00= $364.00 for picking materials for a small growers).

Large growers do not have to purchase single-use trays since most strawberries moving into the retail market are field packed directly into plastic clamshells or other single use containers, so the expense is already included in existing cost of production estimates. Many large growers of fresh strawberries still move their berries to a cooling pad prior to loading them on a truck for shipment. To minimize the risk of contamination, this pad needs to be cleaned weekly and kept free from pests. Since the size of this pad is likely larger than a typical farm stand or shed, 2 hours of labor are budgeted at $9.61 plus $4.00 for cleaning supplies each week ($23.22/week or $534.00 for Florida for the five month long season, and $1,138.00 for California for the eleven month season).

Table 6. Cost calculations for GAP #3

GAP #3 – Shed/stand sanitation plus reusable containers	Labor wage rate	Labor time	Number of laborers	Materials	# of times in the season (weekly)	Total
Small growers	$7.56	1	1	$372.00	4	$402.00
Large growers-CA	$9.61	2	1	$4.00	49	$1,138.00
Large growers-FL	$9.61	2	1	$4.00	23	$534.00

4. Monitoring irrigation water quality

Contaminated irrigation water can introduced harmful pathogens, especially when irrigation is carried out in a manner that maximizes contact with fruit, for example, overhead irrigation near harvest time. Drip and furrow irrigation both minimize water contact with strawberries. Other ways to minimize contact with contaminated water are to regularly test irrigation water sources, and if need be, establish a new source of irrigation water. Water testing and monitoring are inexpensive ways to reduce the likelihood of microbial contamination. For example, at the Michigan Department of Environmental Quality water lab in Lansing, a standard water test for the presence of bacterial coliforms costs $12.00, at the Oregon State University Microbiology Department in Corvallis a similar test is $12.50. Additional costs associated with water monitoring include record keeping. Exclusion of livestock from surface water sources is another way to reduce potential contaminants, however, in this study we assume that all irrigation water sources are wells.

Small growers should test their water source once per year, so the expense for this GAP, using the average of the two figures above, is $12.25 plus two hours for record keeping at the management rate ($9.78 * 2 + $12.25 = $31.81).

Large growers likely have more than one water source for their irrigation needs, because of the volume needed and because at least some of their fields will be in different locations. For

this GAP large growers are charged for two tests of three different water sources each year, plus six hours of labor for testing and record keeping ($12.25 * 6 + $12.51 * 6 = $148.56).

Well drilling is a more expensive option, but necessary if a contaminated source of irrigation water is being used. The cost to drill a new well varies greatly by region, and in most cost of production estimates the well is assumed to exist on the property.

Table 7. Cost calculations for GAP #4

GAP #4 – Monitoring irrigation water quality	Labor wage rate	Labor time	Testing service	# of tests per year	Total
Small growers	$9.78	2	$12.25	1	$32.00
Large growers – CA and FL	$12.51	6	$12.25	6	$149.00

5. Developing a crisis management plan

Once a food safety outbreak occurs and it is traced back to a single farm, a plan to manage the source of the outbreak is important. Additionally, plans to communicate with suppliers and buyers and the public should be in place before an outbreak occurs. The time spent developing a crisis management plan and training employees is the primary cost associated with this GAP. The first step in developing a plan is to train at least two people to communicate with the media, buyers, and suppliers. The second step is to develop a protocol for when a crisis arises that includes lists of whom to contact when and what part of the business can be suspended. Training two employees will require a third-party trainer to visit the business and fees charged by such trainers are also a direct expense associated with adopting this GAP. Costs for this GAP are the trainer's fee of $500/day and labor expense for two employees for 10 hours each.

For small growers, the expense for this GAP is $500 for the trainer plus 10 hours of labor for an hourly employee and a manager ($500 + $7.56*10 + $9.78*10= $673.40).

For large growers, the expense for this GAP is $500 for the trainer plus 10 hours of labor for two managers ($500 + (($12.51*10)*2)=$750.20).

Table 8. Cost calculations for GAP #5

GAP #5 – Developing a crisis management plan	Labor wage rate		Labor time		Trainer Fee	Total
	Hourly	Management	Hourly	Management		
Small growers	$7.12	$9.83	10	10	$500.00	$670.00
Large growers – CA and FL		$12.51		20	$500.00	$750.00

Costs of third party certification for food safety

Private certification of on-farm food safety practices is an increasingly popular requirement among large retailers. The cost of third party certification by private firms, like Primuslabs, inc. or DavisFresh Technologies, is not public information. Information from experts in the strawberry industry and growers who have become certified by a private firm suggests that initial certification for a large strawberry producer would be $8000.00 in addition to the costs of physically adopting the GAPs. This amount is likely too large for most small growers in this study, so the additional costs of certification are calculated only for large growers. The per acre cost of third party certification for growers in the large production regions is listed in table 9 below.

Table 9. Additional production costs from third party certification

Region	**Average per acre production (lb)**	**Average farm size (acres)**	**Additional $8,000.00 for third party certification**	**Additional cost of third party certification ($/lb)**
Oxnard Plain-CA	56,540	47	$170	0.003
Santa Maria Valley-CA	60,820	47	$170	0.003
Central Coast-CA	42,740	47	$170	0.004
Florida	21,996	30	$267	0.012

Conclusion

GAPs are an important step toward managing microbial contamination in fresh produce. In recent years, strawberry sales have suffered from food safety incidents which might have been

prevented had a GAPs system been in place. In fresh strawberries, GAPs do increase costs of production. Viewed as costs per acre, or costs per pound, the additional expense of GAPs adoption is not trivial. Since many of the costs associated with GAPs adoption do not vary with farm size or the amount of strawberries produced, smaller growers incur relatively higher costs than do larger growers. Working down through table 10, it is clear that the fixed costs of GAPs adoption are larger for the smaller growers at the bottom of the table that they are for the large growers at the top of the table. In this case, growers in California and Florida are large in average farm size and large in the sense of yields per acre. In California, one of the most expensive GAPs for large growers, the provision of toilets and handwashing facilities for workers, is already built into cost of production estimates, and so, among the large growers, the cost of GAPs adoption is more for growers in Florida since this GAP is not automatically included as an expense in the existing cost of production budgets.

Table 10. Additional costs of GAPs adoption

Region	Average production (lb/acre)[a]	Average total production (lbs/acre*average acres)	Additional production cost of GAPs ($/acre)[b]	Additional production cost of GAPs ($/lb)
Oxnard Plain-CA	56,540	2,657,380	$66.00	0.001

Santa Maria Valley-CA	60,820	2,858,540	$66.00	0.001
Central Coast-CA	42,740	2,008,780	$66.00	0.001
Florida	21,996	659,880	$184.00	0.008
Oregon	11,500	103,500	$288.00	0.025
North Carolina	10,000	40,000	$288.00	0.029
Washington	9,000	81,000	$288.00	0.032
Pennsylvania	6,400	12,800	$288.00	0.045
Michigan	5,300	21,200	$288.00	0.054
Wisconsin	5,000	15,000	$288.00	0.058
Ohio	4,800	9,600	$288.00	0.060
New York	3,300	6,600	$288.00	0.087

[a]The average production estimates in Table 10 are different from those in Table 2. These numbers reflect a more current estimate of actual average production than those used in Table 2, which are from cost of production budgets and in many cases are dated. Average production estimates are from the Non-Citrus Fruits and Nuts Summary, July 2004, excluding California, where estimates from the County Agricultural Commissioners' Data report from September 2003 were used.

[b]GAPs costs for California are lower than for Florida since current cost of production estimates include the expense of toilet and handwashing facilities

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