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# Motivations of Fresh-Cut Produce Firms to Implement Quality Management Systems

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A survey of the fresh-cut produce industry (e.g., bagged salads, baby carrots, stir-fry mixes, cut-fruit mixes) shows firms' motivation to adopt quality management systems and the effects of implementation on firms and their relationships with suppliers and customers. Data from surveyed members of the International Fresh-cut Produce Association suggest that system adoption was very widespread. The effects were intra-firm (e.g., improved management and efficiency of quality systems) and inter-firm (e.g., improved identification and facilitation of trade with firms in the supply chain). Satisfaction with adoption of quality management systems was linked to many of the same factors.

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The food industry is undergoing important changes driven by new technologies, institutional relationships, demand conditions, private supply chain standards, and public regulatory requirements. There is a rapidly increasing interest in quality assurance for such attributes as food safety, taste, appearance, and production practices (e.g., organic). Quality management systems (QMS) are the major vehicles used by companies to respond to this interest (Caswell, Bredahl, and Hooker).

QMS encompasses a broad range of efforts. A leading developer of certification standards for such systems, the International Organization for Standardization (ISO), defines a quality management system as "the organization's structure for managing its processes—or activities—that transform inputs of resources into a product or service which meet the organization's objectives . . . this means what

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the organization does to fulfill: the customer's quality requirements, and applicable regulatory requirements, while aiming to enhance customer satisfaction, and achieve continual improvement of its performance in pursuit of these objectives" (International Organization for Standardization). Examples of QMS include Hazard Analysis Critical Control Points (HACCP) and ISO 9000 certification (see figure 1 for details on these and other QMS).

**Figure 1. Quality Management Systems in the fresh-cut produce industry**

**American Institute of Baking (AIB).** See third party programs.

**Certified Organic.** Organic certification is voluntary. Since 2002, product sold in the U.S. as organic must be certified as meeting U.S. Department of Agriculture standards. For example, for plant products the standards prohibit the use of most conventional pesticides; fertilizers made with synthetic ingredients or sewage sludge; bioengineering; or ionizing radiation. See <http://www.ams.usda.gov/nop/indexIE.htm>

**Good Agricultural Practices (GAP).** General guidance used to direct domestic and international food producers in growing, harvesting, sorting, packing, and storage operations to reduce microbial food safety hazards. The U.S. Food and Drug Administration (<http://www.cfsan.fda.gov/~dms/prodplan.html>) and many other organizations are active in developing GAPs for produce.

**Good Manufacturing Practices (GMP).** For products under its jurisdiction, GMPs are guidance that provides criteria for complying with provisions of the Federal Food, Drug, and Cosmetic Act, which requires that all human foods be free from adulteration (impurities). These regulations form the basis of production and preparation of safe food and include criteria for disease control, cleanliness (personal hygiene and dress codes), education, and training. More generally, GMPs set standards for practices in food processing facilities. The U.S. Food and Drug Administration (<http://www.cfsan.fda.gov/~dms/prodplan.html>) and many other organizations are active in developing GMPs for produce.

**Hazard Analysis Critical Control Points (HACCP).** The HACCP system encompasses seven basic principles for quality assurance: identify the potential hazards; identify their critical control points (CCP); establish critical limits and preventive measures to control them; establish monitoring schedules; establish responses to potential uncontrolled CCP; establish verification procedures to make sure the HACCP is working properly; and establish documentation and appropriate records for the application of HACCP. It is primarily used to assure food safety. In the United States, it is voluntary in the fresh-cut produce industry but mandatory for meat and poultry processing, in the seafood industry, and for a limited number of other products.

**In-house system (IHS).** Proprietary quality assurance system developed by the firm.

## Figure 1. Continued

**ISO 9000.** A generic set of standards developed by the International Organization for Standardization for certifying the quality assurance program for any type of organization. It has become an international reference for quality management requirements in business-to-business dealings. ISO 9001 requires 20 clauses: management responsibilities; quality systems; contract review; design control; document and data control; purchasing; control of customer-supplied product; product identification and traceability; process control, inspection and testing; control of inspection; measurement and tests; inspection and test status; control of nonconforming products; corrective and preventive actions; post-production stages (handling, packaging, delivery); control of quality records; internal quality audits, training, servicing; and statistical techniques. Other standards in the 9000 series require subsets of these standards. See <http://www.iso.org/iso/en/ISOOnline.frontpage>

**National Sanitation Foundation (NSF).** See third party programs.

**Primus Laboratories.** See third party programs.

**Qualified Through Verification (QTV).** A voluntary USDA program. It helps food processors and buyers produce and distribute wholesome and safe fresh-cut fruits, vegetables, and related products. QTV encourages a proactive approach for identifying process deficiencies during rather than after production.

**Silliker Laboratories.** See third party programs.

**Third party programs:** Firms or organizations that conduct food safety audits, provide tests and analyses, and certify companies' products. Their mission is to develop and administer training and programs relating to public health and the environment. Examples include the American Institute of Baking, National Sanitation Foundation, Primus Laboratories, and Silliker Laboratories.

What motivates firms to adopt QMS? What are the effects of adoption on the firm and its relationships with suppliers and customers? How satisfied are firms with their QMS after adoption? Because adoption of QMS is occurring at varying rates in different sectors, industry-level studies provide important insights into understanding the rate of adoption as well as strategic and economic incentives for QMS use.

In this paper, we examine the U.S. fresh-cut (e.g., bagged salads, baby carrots, stir-fry mixes, cut-fruit mixes) produce industry. In recent years, U.S. consumers have significantly increased fresh-cut fruit and vegetable purchases. At the same time, the fresh-cut produce industry experienced important changes in technology, structure, consumer preferences, trading practices within the supply chain, and international competition. The perishable nature of fresh-cut produce makes quality hard to ensure along the supply chain. Consequently, firms are being

forced to change the way they produce and supply products, influencing relationships within their supply chains.

### **Trends in the U.S. Fresh and Fresh-Cut Produce Industry**

The U.S. fresh produce industry has been expanding while experiencing significant changes. Consumers increased their per capita consumption of fresh fruit from 121 pounds in 1987 to 130 pounds in 2000. Per capita fresh vegetable consumption rose from 162 to 196 pounds over the same period (Dimitri, Tegene, and Kaufman). There have also been significant structural changes in the market through acquisition and consolidation among processors, wholesalers, and retailers. For example, between 1996 and 1999, there were 385 mergers in the grocery industry with the acquired firms having over \$67 billion in annual sales (Richards and Patterson).

Supply chain marketing and trade practices have been affected by retail consolidation, changes in technology, increased demand for convenience, and year-round availability. In total, \$70.5 billion of produce was sold to U.S. consumers by retail stores, food service, and direct marketing in 1997. The share of consumer sales via direct marketing has stayed constant at around 1.6% (Kaufman et al.). Richards and Patterson found that 43% of fresh produce is marketed directly from growers to retailers. Larger retailers may buy as much as 66% of their supplies directly from growers. Calvin et al. found that fees and services requested of growers and shippers by wholesalers and retailers have increased recently. Supply chain relationships in the fresh produce sector are now among larger, more closely connected firms.

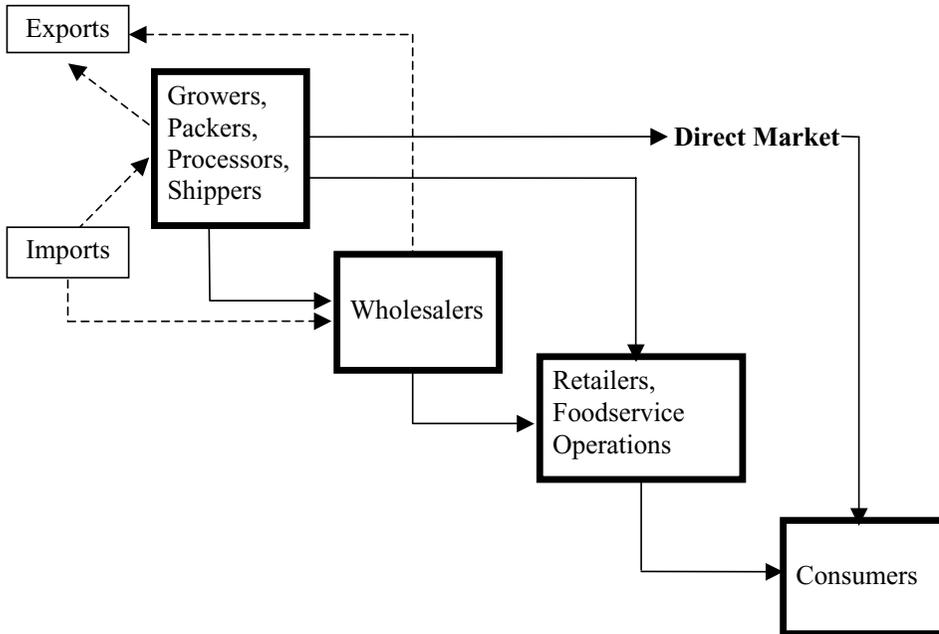
The fresh-cut segment of the produce sector has experienced rapid growth, fueled by consumer demand for convenient, healthy foods, and foodservice demand for labor-saving inputs. The International Fresh-cut Produce Association (IFPA<sup>1</sup>) estimates that U.S. sales of fresh-cuts grew from about \$5 billion in 1994 to \$10–12 billion currently, representing about 10% of total produce sales to retailers and foodservice companies. Growth in sales of packaged salads has been particularly rapid (International Fresh-cut Produce Association; Glaser, Lucier, and Thompson).

Figure 2 shows an overview of the supply chain in the fresh-cut segment. A diverse set of companies may combine growing, processing, packing, and shipping. The major sales channels are through wholesalers and direct sales to retailers and food service operations. The perishable nature of fresh-cut produce poses a challenge in assuring food safety and other quality attributes of the products along the supply chain.

### **Incentives for QMS Adoption**

Implementation of QMS depends on the internal benefits and costs of firms, risk management, and competitive advantage (Caswell, Bredahl, and Hooker). Research suggests that the most likely sources of firm-level benefits from adopting QMS come from a margin premium received for selling a higher quality product, a reduction in costs (production, transaction, or compliance), and an improved understanding of its own quality system. This improved understanding of the

**Figure 2. Fresh-cut produce supply chain**



sources of quality problems (e.g., erratic quality of inputs or improper temperature control) frequently leads to more efficient controls and better plant performance.

In a study of fifteen tomato growers, Alexander, Goodhue, and Rausser showed that the growers responded to contractual price incentives linked to quality by increasing the quality of tomatoes. They also found that eliminating the price incentives for higher quality tomatoes decreased the quality of tomatoes. Holleran and Bredahl found that 52% of British firms that adopted ISO 9000 as a QMS were internally motivated, while 36% stated that adoption was externally driven, and 12% were motivated by both internal and external factors. Other benefits of enhanced quality management include fewer consumer complaints, less quality variability, less variability in premiums, less rework, better intra-firm communication and management, and greater attraction of new customers.

Implementation of QMS comes at a (sunk) cost, even if it eventually lowers costs. The main costs include personnel training and acquisition of new equipment for control and testing. Also, there may be significant costs associated with the day-to-day operations such as continued training for employees, recording, testing, audits, consultants' fees, and registration fees if the firm is certified by a third party. Zaibet and Bredahl analyzed the effects of ISO 9000 implementation on four UK meat companies and found that benefits exceeded expenses, with production costs reduced through a lower rejection rate, reduced rework, and less non-conformity of the products to the quality standards.

Better management of transaction costs between buyers and sellers and access to contracts is likely to be an important motivation for QMS adoption in the produce

industry where information, especially on quality, is asymmetric. Holleran and Bredahl found that ISO 9000, for example, is likely to be adopted in sectors where transaction costs are high (e.g., at the second stage processor level). QMS adoption can enhance quality signaling among firms in a supply chain, thus mitigating the effect of quality uncertainty. On the supplier side, QMS adoption can be used to identify and attract downstream buyers. On the buyer side, QMS adoption by suppliers can facilitate contracting by reducing the time and resources needed to identify qualified suppliers, negotiate contracts, inspect quality, and enforce contracts.

Management of liability exposure may be another important motivation for implementing QMS. Evidence suggests that firms will adopt QMS to avoid being held liable for defective products and/or for not exercising adequate safety and control plans. Buyers may litigate against suppliers for damages as occurred in the 1993 *E. coli* O157:H7 outbreak in the United States (Buzby, Frenzen, and Rasco). U.S. firms are legally liable for non-conformities with safety standards even if their quality control systems met specific requirements. QMS adoption has the advantage of decreasing the risk of product safety failure.

Motivation for adopting QMS may differ depending on firm size. Evidence suggests that large firms have a stronger incentive to adopt QMS than small firms, which are generally later, more partial, or non-adopters of QMS (Holleran and Bredahl). Differences in motivation may stem from firm expectations. In a survey of 647 British firms that were ISO-registered, Seddon et al. found that 51% of large firms anticipated cost reductions from ISO implementation, compared with 30% of small.

Finally, governments, international institutions, and/or customer requirements can drive firms' adoption of QMS. To avoid foodborne illness, a government may mandate a QMS such as HACCP. Participation in international trade may require firms to adopt ISO 9000. In addition, a supply chain may require firm-specific QMS (e.g., a retailer-led scheme) for participation.

## **Survey and Methodology**

Members of the International Fresh-cut Produce Association (IFPA), the main trade association for the fresh-cut produce industry, were surveyed by mail in March and April 2003 to gauge several aspects of QMS adoption: level of use, motivations, and effects on the firms and their supply chain relationships. Only firms with U.S. operations were surveyed. The survey was sent to 272 companies that were producers, shippers, packers, distributors, processors, wholesalers, retailers, or importers.

The survey was distributed under university letterhead. It was administered using the Dillman total design method with an initial mailing including an explanatory letter and survey. We sent a reminder letter and follow-up mailing with an additional copy of the survey. We received twenty-eight surveys in response to the first mailing and an additional ten surveys from the follow-up mailings. In total, thirty-eight out of 272 companies surveyed completed and returned the questionnaire for a response rate of 14%. Response rates on these types of studies are frequently low.

**Table 1. Characteristics of the surveyed fresh-cut produce firms**

	Frequency	Percentage
Total gross value of annual sales		
Less than \$1,000,000	2	5.9
\$1,000,000–\$9,999,999	13	38.2
\$10,000,000–\$19,999,999	6	17.7
Greater or equal to \$20,000,000	13	38.2
Cumulative frequency/percentage	34	100.0
Number of employees		
1–49	12	32.4
50–99	7	18.9
100–499	15	40.6
>499	3	8.1
Cumulative frequency/percentage	37	100.0
Goods produced		
Inputs and/or intermediate goods	5	13.5
Final goods	22	59.5
Other <sup>a</sup>	10	27.0
Cumulative frequency/percentage	37	100.0
Nature of business		
At least processors <sup>b</sup>	28	75.7
Others	9	24.3
Cumulative frequency/percentage	37	100.0
Affiliated with a parent company or part of a multi-plant operation		
Yes	7	18.9
No	30	81.1
Cumulative frequency/percentage	37	100.0
Number of QMS in place		
One	29	76.3
Two	4	10.5
Three	3	7.9
More than three	2	5.3
Cumulative frequency/percentage	38	100.0

<sup>a</sup>Firms that supply inputs and/or intermediate goods and final goods at the same time.

<sup>b</sup>Processors that may include other activities such as growing, packing, or retailing.

The characteristics of the surveyed firms suggest that the respondents represent a wide range of the industry (table 1). Because of missing values, the number of observations in each characteristic category may vary. Two firms out of thirty-four, for example, are small with total gross annual sales of less than \$1 million; nineteen firms are of medium size with sales equal to or greater than \$1 million and less than \$20 million; and thirteen firms are large with sales of \$20 million or more. Twelve firms have less than fifty employees, seven have between fifty and ninety-nine employees, and eighteen have 100 or more employees. Five firms out of thirty-seven (13.5%) supply only inputs and/or intermediate goods, while twenty-two firms (59.5%) produce only final goods. The remaining firms produce inputs and/or intermediate goods and final products. Seven out of

thirty-seven firms (18.9%) are affiliated with a parent company or part of a multi-plant operation.

There are very little data available on the structure of the fresh-cut produce industry that allows evaluation of how representative the surveyed firms are of the entire industry. With IFPA data, however, we can compare the distribution of the number of firms by size of sales among processors who were IFPA members in 2003 and processors in our sample using the IFPA sales categories. Within IFPA, 56% of the processor members were in the category \$0–5 million sales; 20% in \$5–15 million; and 24% in more than \$15 million. In contrast, 28% of survey respondents had sales of \$0–5 million; 20% of \$5–15 million; and 52% of more than \$15 million. Thus, the survey respondents under represent small and over represent large processors, as compared to the IFPA membership.

While not representing the number of firms in the fresh-cut industry, the survey respondents have the advantage of providing an in-depth view weighted toward the experience of larger firms that conduct the bulk of the business in the sector. Conversations with IFPA and the business press indicate that these firms are more reflective of general industry trends toward adoption of QMS. There may be a bias in the pattern of response, with firms that have already implemented QMS being more eager to respond.

This evaluation of the representativeness of the survey respondents suggests that the results should be considered to reflect more strongly the experience of larger firms and those firms that are more knowledgeable about QMS. In this context, results are reported for the survey respondents without drawing conclusions about the experience of the industry as a whole. However, all indicators suggest that the trends discussed here are generally representative of the direction of the fresh-cut industry.

### ***Survey Questions***

Table 2 shows a sample of the four types of survey questions. For most questions, firms were asked to indicate their agreement with statements about their experience with QMS adoption using a five-point Likert scale. Other yes/no, choice, and open-ended format questions were asked.

The analytical methodology first explored the firms' perceptions of the relative importance of changes from implementing QMS. The dominant changes

**Table 2. Sample questions used in the survey**

Satisfaction with Prices of Your Product(s)	It Is Difficult to Identify Customers	How Did Your Product Traceability Change Since Your Firm Implemented the Current QMS?	Is Your Firm Affiliated with a Parent Company?	By Which 3rd Party Is Your Current QMS Certified?
<input type="checkbox"/> Very satisfied	<input type="checkbox"/> Strongly agree	<input type="checkbox"/> Greatly increased	<input type="checkbox"/> Yes	
<input type="checkbox"/> Somewhat satisfied	<input type="checkbox"/> Somewhat agree	<input type="checkbox"/> Somewhat increased	<input type="checkbox"/> No	
<input type="checkbox"/> Neutral	<input type="checkbox"/> Neutral	<input type="checkbox"/> Stayed the same		
<input type="checkbox"/> Somewhat dissatisfied	<input type="checkbox"/> Somewhat disagree	<input type="checkbox"/> Somewhat decreased		
<input type="checkbox"/> Very dissatisfied	<input type="checkbox"/> Strongly disagree	<input type="checkbox"/> Greatly decreased		
<input type="checkbox"/> Not applicable	<input type="checkbox"/> Not applicable	<input type="checkbox"/> Not applicable		

*Note:* Survey available upon request.

may be seen as results of QMS implementation but also as prime motivators for adoption. Either means or medians can be considered for comparing ordinal variables. In this case, the results for medians were generally consistent with those for means, which are used in the analysis. A one-tailed *t*-test was used to determine whether the mean score for a scale variable was lower or higher than the “baseline” or mid-point score of three, which indicates a neutral or “stayed the same” answer.

Next, we used cross-tabulations to identify variables that are associated with the firms’ reported satisfaction with QMS (SQMS), which takes on a value from one (very dissatisfied) to five (very satisfied). In bivariate analysis, tests of independence using the Pearson and Likelihood ratio chi-squares treat both variables in the cross-tabulation as nominal. Since both rows and columns of most variables in these data can be considered to be on an ordinal scale, the Mantel–Haenszel (MH) correlation statistic that uses ordinality is more appropriate to test the null hypothesis ( $H_0$ ) that there is no association between variables. This test is also appropriate when the column (row) variable is ordinally scaled and the row (column) variable is dichotomous. Given the small sample size, the asymptotic MH chi-square may not be a valid test. Alternatively, the MH exact test was performed and categories of scaled independent variables were also collapsed to a smaller number of categories. For instance, the new scores for variables that measure the level of satisfaction with prices are: 1 = dissatisfied (includes very and somewhat dissatisfied), 2 = neutral, and 3 = satisfied (includes very and somewhat satisfied).

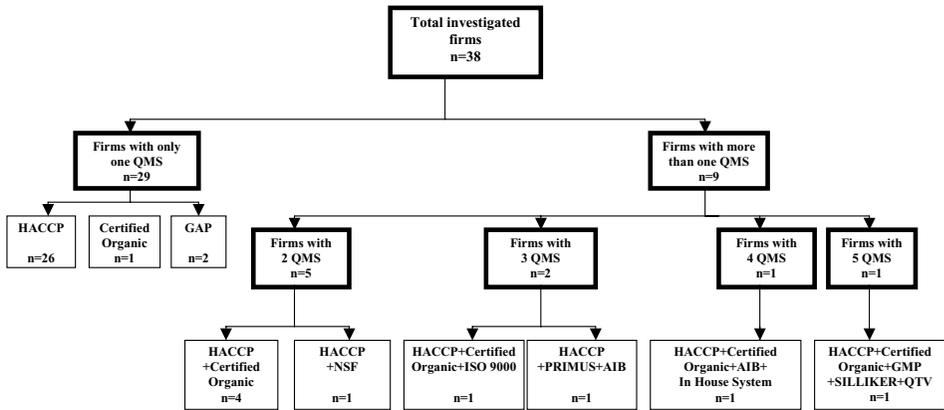
## **Adoption of and Satisfaction with QMS in the Fresh-Cut Produce Industry**

Clearly the environment in the fresh-cut industry provides important incentives to manage quality. All thirty-eight surveyed firms have at least one QMS in place (table 1). Twenty-nine out of the thirty-eight (76.3%) firms have only one QMS, the remaining nine firms (23.7%) have two to five QMS in place at the same time.

Figure 3 shows the types and patterns of QMS adoption (see figure 1 for details of specific QMS). The Hazard Analysis Critical Control Points (HACCP) quality management system, which focuses on the management of food safety risks, is almost universally used among the surveyed firms. Thirty-five of the thirty-eight (92.1%) firms have HACCP in place. This indicates the key importance of food safety assurance in the fresh-cut produce industry. Eight (21.1%) of the surveyed firms have a certified organic QMS and one (2.6%) has ISO 9000. In addition, eleven other QMS were reported to be in use, often in combination with other QMS. These include: Good Agricultural Practices (GAP), Qualified Through Verification (QTV), Good Manufacturing Practices (GMP), in-house systems (IHS), and third party programs managed by Silliker Laboratories, Primus Laboratories, American Institute of Baking (AIB), and the National Sanitation Foundation (NSF).

As noted, HACCP is the common denominator in QMS adoption. Of the thirty-five firms with HACCP, twenty-six did not have another QMS in place, while five had one additional QMS in place, two had two more QMS, one had three more systems, and one had four more. Of the three companies that had not adopted HACCP, one has certified organic and the other uses GAP as its QMS. QMS

**Figure 3. Adoption of different QMS by firms in the fresh-cut produce industry**



adoption was the absolute norm among the surveyed firms, with about 24% of the surveyed firms implementing a suite of more than one QMS. Among the surveyed companies, no firm characteristics, including total gross value of annual sales, were associated with the adoption of more than one QMS.

### ***Changes Experienced by Firms with QMS Adoption***

The surveyed firms identified numerous significant changes they experienced with QMS adoption. Table 3 shows benefits of adoption where the mean response is statistically significantly different at 1% from three (stayed the same) in terms of an increase (mean response greater than three) for a desirable characteristic or a decrease (mean response less than three) for an undesirable one. Improvements in product traceability, product quality, and the quality of data available for decision making were among the most significant desirable increases. There were also improvements in the ability to maintain current customers and attract new ones, satisfaction with sales, the quality of purchased inputs, satisfaction with access to the domestic market, and satisfaction with market share. Improvements in the quality of inter-departmental communication and firm productivity did not have mean scores as high but they were still significant. Reductions occurred in undesirable characteristics following QMS adoption, including product failures, product recalls, customer complaints, and warranty claims.

As suggested by previous research, table 3 also shows that the benefits of implementing QMS come at a price. The mean response by the firms was statistically greater than three at a 1% significance level, indicating increased costs for record keeping, monitoring the production process, laboratory analysis, internal audits, and training of personnel. Other cost increases were related to input inventory, calibration, and input inspection. Following adoption of the various QMS, firms experienced increases in the number of internal audits, need for new equipment, time to draft product specifications, and labor for production.

Firms' relationships with customers and suppliers changed after QMS adoption (see table 3). Firms report that they work more on quality assurance with their

**Table 3. Changes experienced by firms after QMS adoption**

Statement/Characteristics	N	Mean Response	t-Value
Benefits experienced by firms after QMS adoption <sup>a,b</sup>			
Increases			
Product traceability	34	4.15	8.14
Quality of the product	37	4.03	7.82
Quality of data for decision making	32	3.91	6.27
Satisfaction with ability to hold on to customers	37	3.84	7.23
Ability to attract new customers	38	3.84	6.37
Satisfaction with sales	38	3.82	6.57
Quality of purchased inputs	36	3.72	5.85
Satisfaction with access to domestic market	38	3.66	5.73
Satisfaction with market share	34	3.56	5.32
Quality of inter-departmental communication	31	3.55	4.52
Firm productivity	31	3.35	2.99
Decreases			
Product failure rate	29	2.31	-4.17
Number of product recalls	25	2.32	-3.78
Frequency of customer complaints	36	2.47	-3.48
Frequency of receiving warranty claims	31	2.58	-2.53
Increases in firms' costs after QMS adoption <sup>a,c</sup>			
Record keeping	33	4.09	9.24
Monitoring production process	34	3.94	8.46
Laboratory analysis	32	3.88	5.46
Internal audit	28	3.86	6.43
Training personnel	33	3.85	7.31
Input inventory	34	3.82	7.67
Cost of calibration	28	3.68	4.97
Input inspection	33	3.52	4.78
Changes in relationships with customers and suppliers after QMS adoption			
Customers <sup>a,c</sup>			
Frequency of working with customers on quality assurance	34	3.88	6.37
Number of customers to choose from	36	3.81	7.74
Likelihood that customers inspect inputs before signing contracts	31	3.61	4.05
Number of audits per customer per year	34	3.56	4.15
Tendency to negotiate long-term contracts with customers	30	3.43	3.79
Time spent with customers to negotiate contracts	33	3.27	2.50
Suppliers			
Frequency of working with suppliers on quality assurance	36	3.69	5.56
Likelihood that you inspect inputs before signing contracts	30	3.53	3.12
Tendency to negotiate long-term contracts with suppliers	30	3.40	2.84
Time needed to draft product specifications with suppliers	36	3.39	3.20
Number of audits for your principal supplier	28	3.36	3.38
Time spent with suppliers to negotiate contracts	34	3.26	2.50

<sup>a</sup>Responses were on a 5-point Likert scale where 1 = greatly decreased and 5 = greatly increased.

<sup>b</sup>Mean responses are statistically significantly higher than 3 (= stayed the same) at 1% for the increases and statistically significantly lower than 3 (= stayed the same) at 1% for the decreases.

<sup>c</sup>Mean responses are statistically significantly higher than 3 (= stayed the same) at 1%.

customers and suppliers, inspect inputs more frequently before signing contracts with suppliers, and have their products inspected more often by customers. Interestingly, the likelihood of signing long-term contracts with customers or suppliers also increased. Firms reported that the average number of audits per customer per year and the average number of audits of suppliers both increased after adopting QMS.

Firms reported that some specific activities and relationships did not change after QMS adoption. For example, there was no change in the frequency of seeking restitution when customers break contracts, liability insurance premiums, satisfaction with profits, frequency of hiring a specialist to assist in contract negotiations, difficulty in identifying customers or suppliers, response time for customer complaints, or frequency of unscheduled maintenance. The number of suppliers to choose from, the cost of wastage, and the cost per product recall also did not significantly change.

### ***Factors Related to Satisfaction with QMS***

The firms' responses suggest the direction and importance of changes experienced after adoption of QMS. How are these and other factors related to satisfaction with QMS? As a starting point, most firms in our study reported that they are satisfied with their QMS. Thirty-four out of thirty-eight (89.5%) reported they were satisfied or very satisfied with QMS. Two firms were very dissatisfied with QMS, while the other two were neutral.

Table 4 reports variables that are associated with satisfaction with QMS, for correlations statistically significant at the 10% or lower level using the MH exact test. As satisfaction with the quality of inter-departmental communication or data for decision making increases, overall satisfaction with QMS adoption rises. Variables regarding relationships with suppliers and customers suggest that negotiating long-term contracts or spending more time with suppliers to negotiate contracts are related to the firm's satisfaction with QMS. The more likely that the firm requires suppliers to have QMS and seeks restitution from its customers when they break contracts, the more likely the firm is satisfied with its QMS. Additionally, having products inspected by customers or having a customer complaint system is associated with overall satisfaction with QMS. Likewise, seeking restitution when suppliers break contracts or having many suppliers to choose is related to a firm's satisfaction with QMS.

Satisfaction with QMS increases as the tendency to sign long-term contracts with suppliers or the time needed to draft product specifications with them increases. After implementing QMS, firms tend to keep the same suppliers by signing long-term contracts to reduce uncertainty and information problems—key components of transaction costs. An increase in satisfaction with QMS is correlated with firms spending more time drafting product specifications with their suppliers. An increase in satisfaction with prices also is related to greater satisfaction with QMS. This suggests that a premium is being paid for better quality products. In addition, having a larger number of customers to choose from is correlated with firm satisfaction with QMS. Finally, firms that are diligent regarding spending more time with their suppliers and customers when negotiating contracts and inspecting inputs are more satisfied with QMS.

**Table 4. Variables associated with satisfaction with QMS**

Questions/Statements	N	Direction of the Association	P-Value (MH Exact Test)
Perception of firm's current situation <sup>a</sup>			
Satisfaction with quality of inter-departmental communication	34	+	0.02
Satisfaction with quality of data for decision making	36	+	0.04
Relations with suppliers and customers <sup>b</sup>			
Negotiate long-term contracts with suppliers	36	+	0.01
Much time spent with suppliers to negotiate contracts	36	+	0.01
You require suppliers have QMS <sup>c</sup>	37		0.02
No		-	
Yes		+	
You seek restitution when customers break contracts	28	+	0.04
Customers inspect product before signing contract	33	+	0.04
Have a customer complaint system	36	+	0.06
You seek restitution when suppliers break contracts	32	+	0.07
Many suppliers to choose from	38	+	0.09
Changes occurring after implementation of QMS <sup>d</sup>			
Tendency to negotiate long-term contracts with suppliers	30	+	0.00
Time needed to draft product specifications with suppliers	36	+	0.02
Satisfaction with prices	38	+	0.04
Time spent with customers to negotiate contracts	33	+	0.06
Number of customers to choose from	36	+	0.07
Time spent with suppliers to negotiate contracts	34	+	0.08
Likelihood that you inspect inputs before signing contracts	30	+	0.10
Firm characteristics			
Nature of business <sup>e</sup>	37		0.08
Processors		+	
Others		-	
Affiliated with a parent company or part of a multi-plant operation <sup>f</sup>	37		0.10
Yes		+	
No		-	

Note: Satisfaction with QMS is an ordered variable that takes values 1 to 5 with 1 = very dissatisfied, 2 = somewhat dissatisfied, 3 = neutral, 4 = somewhat satisfied, and 5 = very satisfied.

<sup>a</sup>Variable that takes values 1 to 3 with 1 = dissatisfied (includes very and somewhat dissatisfied), 2 = neutral, and 3 = satisfied (includes somewhat and very satisfied).

<sup>b</sup>Variable that takes values 1 to 3 with 1 = disagree (includes strongly and somewhat disagree), 2 = neutral, and 3 = agree (includes somewhat and strongly agree).

<sup>c</sup>Binary variable equal to 1 if a firm requires suppliers have QMS and equal to 0 otherwise.

<sup>d</sup>Variable that takes values 1 to 3 with 1 = decreased (includes greatly and somewhat decreased), 2 = stayed the same, and 3 = increased (somewhat and greatly increased).

<sup>e</sup>Binary variable equal to 1 if a firm is a processor and equal to 0 otherwise.

<sup>f</sup>Binary variable equal to 1 if a firm is affiliated with a parent company or is in a multi-plant operation and equal to 0 otherwise.

Two firm characteristics were shown to be associated with overall satisfaction with QMS for this group of surveyed companies. Processors are more likely to be satisfied with QMS than firms that do not process as part of their business (e.g., growers or distributors). Also, having a parent company or being part of a multi-plant operation was associated with satisfaction with QMS. Firm size was not significantly associated with firms' satisfaction with QMS.

## **Conclusions**

Our results show that the surveyed firms in the fresh-cut produce industry are clearly motivated to adopt QMS. All the respondent companies had adopted at least one QMS and several had more than one in place. Comparison of the firms' response to questions and bivariate analysis indicate that QMS adoption affected intra- and inter-firm factors. Intra-firm effects include improved management and efficiency through an enhanced understanding of the quality system and price premiums for better quality products. Inter-firm effects were the ability to identify other firms in the supply chain and facilitate trade with them. Firms with QMS increased their frequency of signing long-term contracts with other firms in their supply chain. Since inter-firm activities are mainly associated with transaction costs, these effects help firms decrease such costs. Surprisingly, firm size was not significantly related to the number of QMS adopted or satisfaction with QMS among the survey respondents.

Findings from the analysis should be interpreted to represent the experience of larger firms and those that are more knowledgeable about QMS adoption. The companies that responded represent an important snapshot of the adoption of QMS in the fresh-cut produce industry, where quality assurance is of growing concern. This is reflected in the fact that all firms that returned the questionnaire had at least one QMS in place and nearly one-quarter had two or more QMS.

These findings are consistent with the literature on what motivates firms to implement QMS. The survey found QMS adoption is indeed an important business practice in the fresh-cut produce industry. Nearly 90% of the firms reported they were somewhat or very satisfied with their QMS, suggesting they attained their objectives with QMS adoption. This survey of the fresh-cut produce industry illustrates the increasingly central role of QMS adoption in the food industry.

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## **Endnote**

<sup>1</sup>IFPA was founded in 1987. It serves over 600 members worldwide, including processors, distributors, and retail and food service buyers of fresh-cut produce, as well as companies that supply goods and services to the fresh-cut industry.

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