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Major Factors Influencing the Competitiveness of the California Strawberry Subsector



By
Jon C. Phillips, Ph.D.
William Jolley

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About the Authors

Jon C. Phillips is an Assistant Professor of Food Marketing and Agribusiness Management at California State Polytechnic University, Pomona. Dr. Phillips also serves as Director of the Center for Food Marketing and Agribusiness Solutions.

William Jolley is an agricultural biology student in the Department of Horticulture, Plant, and Soil Science at California State Polytechnic University, Pomona.

ABSTRACT AND EXECUTIVE SUMMARY

Abstract

With its nearly year-round supply and 83% market share, the California strawberry subsector¹ dominates production and distribution of fresh strawberries in North America. The subsector has achieved its leading position among competitive production regions (e.g., Florida and Oregon) through the development and interaction of several factors. These factors include the following: superior agro-ecological conditions, economies of size, technological innovation, favorable demand conditions, marketing flexibility, and support infrastructure.

Executive Summary

(The following points build on the abstract presented above.)

- California's Pacific coastal climate allows for a very long (i.e., January to November) production season and thus high yields per acre, compared to other production regions. In particular, California has hot, sunny days that encourage sugar development, and cold, foggy nights to ensure outstanding color.
- The California strawberry subsector is large. It has more than four times as many acres as the next largest production region, Florida. This allows California to benefit from economies of size. California growers can spread out fixed costs over more units of output. In addition, California has better access to a labor supply than Florida, and lower labor costs than Oregon.

¹ According to Boughton, et al (1995), a *subsector* is "a set of activities that contribute to the flow of a commodity through the stages of production, distribution, and end use." By way of contrast, industry studies examine a horizontal slice of the production/manufacturing/distribution system.

- Strawberry production has expanded significantly in California over the past three decades. This has provided the opportunity for expanding growers and new entrants in California to adopt the latest, most effective and efficient technology. The expansion opportunity resulted in a second mover advantage for California versus Oregon, which has an older production industry that has not expanded.
- Demand conditions for fresh strawberries have been favorable in recent decades, with steep increases in per capita consumption. Factors that have contributed to this increase include the general increase in consumption of fresh fruit and recently publicized health benefits of strawberries (and berries in general).
- California has the largest number of strawberry marketers (shippers) and processors in the U.S. This provides California growers marketing flexibility, in that they can divert strawberries to the frozen market when fresh market prices are low.
- The California strawberry subsector has an excellent support infrastructure. This includes research into new cultivars conducted by the University of California and the California Strawberry Commission (CSC). (A number of companies, however, do their own research and do not rely on the University of California.) The CSC engages in education and provides research grants. Its promotional programs include separate but integrated plans for retail, export, foodservice, and consumer marketing.

1.0 Introduction

The California Strawberry Commission (2003) estimates that “if all the strawberries produced in California this year were laid berry to berry, they’d wrap around the world 15 times.” From dusty roadside fruit stands to fluorescent supermarket freezers, and in the jams, pies, smoothies and cereal of millions of Americans each day, the popularity of the California strawberry is unrivaled. This phenomenon is not a happy mistake, or some fleeting trend. Instead, it is the result of hard work by many dedicated growers, processors, and research, marketing and public relations agencies - collectively known as the California strawberry subsector. To understand the success of the California strawberry, it is useful to examine the major factors influencing the competitiveness of the subsector. These factors include the subsector participants; cultural practices and product production; emerging trends and demand conditions; distribution, pricing, and promotional methods; and evolving marketing strategies and tactics. In addition, an analysis of the California strawberry subsector must include a preliminary discussion of its role in national and international strawberry production, and the subsector’s place in state agriculture.

2.0 Subsector Approach

At this point, it would be useful to clarify what the term *subsector* means. Traditionally, analysts have looked at horizontal slices of the food system. Industry studies result from this type of approach. Examples of industry studies include examinations of agricultural production (i.e., farming systems), food manufacturing, wholesaling, or retailing industries. Alternatively, we chose to take the subsector approach, examining "a set of activities that contribute to the flow of a commodity through the stages of production, distribution, and end use." (Boughton, et al 1995). Subsector analysis emphasizes the vertical sequences in production and distribution in addition to the methods of coordination that connect the interdependent stages of commodity flows. The subsector framework tracks the channels and transformations of a

given commodity. It examines not only physical transformation processes, but also the policies and institutions that establish the incentives for exchange, risk management, dissemination of information, and innovation.

3.0 Background and Basic Facts

According to Cook (2002), the United States strawberry subsector is, as part of the U.S. fresh fruit sector, second in overall value. California leads the nation in strawberry production, producing 83% of the strawberries consumed in North America (Office of Technology Transfer 2004). California strawberry growers account for approximately 55% of the nation's strawberry production area (Cook 2002). Florida, Oregon, and North Carolina strawberry industries account for much of the remaining production and production area. With Florida, Oregon, and Louisiana experiencing declining strawberry production and production area, however, California's is expected to see an impressive rise in national market share (Cook 2002). What can account for the success of the California strawberry subsector over competing states? California's strawberry growers utilize the state's unique coastal environment to produce over 1.4 billion pounds of fruit, a crop estimated to be worth \$700 million annually (California Strawberry Commission 2003). California strawberry acreage boasts the highest yields in the nation, an average of "25 tons per acre, up to five times the yield of other production areas" (California Strawberry Commission 2004a). Hot, sunny days encourage sugar development, while cold, foggy nights (generated by the Pacific Ocean) ensure outstanding color. Further, California's dry climate allows growers to control the water supply to plants (through irrigation), which lessens the risk of certain diseases. Wetter production regions, e.g., Florida, have a greater risk of problems in this area.

The success of the California strawberry subsector is also due to its marketing flexibility. Although most strawberry production is for the fresh market, "one of the strengths of the California strawberry industry," notes Cook (2002), "is its dual usage nature, allowing product to move into the freezer market (usually 25%) when fresh prices are low." In contrast, the Oregon strawberry subsector focuses primarily on specific

ingredient markets (e.g., yogurt, ice cream, and bakery) and the Japanese export market (Finn 2002), while Florida and North Carolina industries emphasize fresh markets.

California is also a leader in exporting fresh strawberries. As discussed earlier, California grown strawberries represent the vast majority of the United States' total strawberry production. Net exports account for 10% of the nation's total annual strawberry production, and imports of fresh strawberries provide only 6% of the United States' annual consumption. Thus, the United States, and therefore California, is still primarily an exporter of fresh strawberries (Cook 2002). While the United States is usually a net importer of frozen strawberries, this does not significantly affect the California strawberry subsector, as California strawberries do not represent a significant percentage of the United States' total frozen strawberry production. As a result of Mexico's proximity, and the perishable nature of the strawberry, Mexican strawberries represent nearly all of the imported fresh and frozen strawberries to the United States (Cook 2002).

In California, the strawberry industry represents the tenth highest grossing industry based on 2002 cash receipts (Barton 2003). According to the 1997 Census of Agriculture, strawberries were grown on 27,582 of California's 17,460,197 irrigated acres of farmland (National Agricultural Statistics Service 1997). According to Partida (2004), there are currently almost 29,500 acres of strawberries grown in California. California strawberries are grown in coastal regions throughout the state. Northern growing regions include Santa Cruz, Monterey and San Benito Counties. Growers in Watsonville and Salinas, located in Santa Cruz and Monterey Counties, respectively, farm more than half of the state's strawberry production area (California Strawberry Commission 2003). Central growing regions include areas of San Luis Obispo and Santa Barbara Counties. Southern growing regions include San Diego, Orange, Los Angeles, and Ventura Counties. In Ventura County, strawberries are the leading commodity. Most of these berries are grown in Oxnard, and this commodity helped to establish the county as a member of the state's "2002 Billion Dollar Club" (Barton 2003).

4.0 Subsector Participants

The structure of the California strawberry subsector can be best understood by jointly examining growers and processors. According to 1997 Census of Agriculture data, there were 755 farms in California that produce strawberries as a primary crop. (National Agricultural Statistics Service 1997). However, a more recent report suggests there are only 400 commercial strawberry growers in California (Cook 2002). When evaluating farm size, a bimodal distribution of farm acreage becomes evident - the acreage of individual California strawberry farms tends to be either large or small. Bertelsen (1995) states that large (i.e., sales of at least \$500,000) strawberry farms averaged 244 acres while small (i.e., sales of less than \$10,000) farms averaged 4 acres. The Florida fresh strawberry production industry also exhibits a bimodal distribution concerning farm size (Tomlinson, et al 2004). There are sixteen strawberry processors in California who purchase and process raw strawberries. There are also two or three who purchase processed strawberries and engage in further processing (Faxon 2004). The California strawberry subsector also includes 90 marketers of fresh strawberries (versus 50 in Florida) and five cooperatives and grower-processors (Cook 2002). These firms, with the help of contracted growers and in house processing facilities, are responsible for over half of California's fresh and frozen strawberry production each year (Cook 2002).

Market share for the California's top strawberry cooperative, Driscoll's Strawberry, is estimated to be 20% (Cook 2002). Driscoll's primary location of operation is in Watsonville, with smaller facilities throughout the state. The heart of Driscoll's strawberry program is the growers, a group well known for their concern for quality and innovation. Another important grower-processor in the California strawberry subsector is the Coastal Berry Company. Coastal has facilities throughout the state in many different growing regions. This allows Coastal to harvest strawberries throughout the year. Coastal's largest operations are located in Watsonville, Irvine, and Oxnard (Coastal Berry Company 2003). Currently, Coastal is undergoing a period of significant growth. Coastal Berry Company recently formed a partnership with Sunkist Growers, Inc., the well known California citrus cooperative. Coastal's CEO, John Gargiulo, noted

that “Sunkist is one of the best known and most trusted names in fresh produce” (Foltz 2003). Gargiulo explained that the ability to “coattail on a large infrastructure and huge brand... gives Coastal an opportunity for higher returns” (Foltz 2003).

The California strawberry subsector also includes organizations that provide marketing, public relations, and research services. The set of organizations with these functions has been termed *support infrastructure* by Phillips (2002). The California Strawberry Commission (CSC) is an agency that participates in research, education/issues management, and promotion of strawberries. An elected Board of Directors guides the CSC, which was established via enabling legislation and a referendum by growers in 1993. This organization was founded to “oversee and conduct agricultural research, promote California strawberries through marketing programs targeting consumers, retail trade, foodservice operators and export markets, and maintain public relations” (California Strawberry Commission 2003). The CSC grants funding for research with potential to directly benefit the California strawberry industry. (During the 2003-2004 season, the CSC made \$901,446 worth of grants.) According to the RFP, proposals are encouraged in the following areas: nursery plant health, pest and disease control, pomology and breeding, and regulatory/strategic research (California Strawberry Commission 2003). The CSC engages in consumer education through its web site, <http://www.calstrawberry.com>. It also distributes printed materials to educate consumers and supply chain participants about strawberries. Regarding promotion, it has separate but integrated plans for retail, export, foodservice, and consumer marketing (Taylor 2001). The theme of its current promotional campaign is "Get the Red Edge."

Strawberry research has been ongoing in California for more than 40 years. The University of California hosts an active strawberry breeding program. This program is led by Dr. D. Shaw (Professor of Pomology, U.C. Davis), and Dr. K. Larson (Extension Specialist/Pomologist, South Coast Research and Extension Center, Irvine). The program has developed several strawberry cultivars, six of which are patented and available for licensing. The program uses traditional crossbreeding, so no strawberry varieties have been developed under the program using genetic engineering techniques.

An objective of the program is to develop cultivars "with specific adaptation for California climates and cultural environments" (Office of Technology Transfer 2004). A recent development is for companies to do their own research and cultivar development (Finn 2002). Once firms attain sufficient size to conduct cultivar research, they are motivated to do so due to potential gains from successful, proprietary cultivars.

5.0 Cultural Practices and Product Production

The California strawberry subsector begins in the field. Before planting, strawberry land is generally fumigated using methyl bromide and chloropicrin to protect the new strawberry plants from insects and soil borne diseases. Pre-plant fertilizers are generally applied to the soil following fumigation. The acreage is divided into manageable fields, usually 280 to 400 feet long, and soil is formed into narrow beds (Klonsky and DeMoura 2003). Polyethylene mulch, a tarp of black or clear plastic, is applied to the soil to suppress weed growth, improve soil warming, conserve soil moisture, and separate the new strawberry plants from the wet ground. With preplanting complete, young strawberry plants can be hand placed in preformed beds at a standard rate of 29,495 plants per acre (Klonsky and DeMoura 2003). Sprinkler irrigation systems are usually used on younger plants, while drip irrigation systems are usually used on mature strawberry plants. Control of invertebrate pests, including two spotted spider mites and lygus bugs, is afforded using narrow range oils and organophosphate, carbonate, and pyrethroid insecticides (National Science Foundation Center for Integrated Pest Management 2003).

In California, farm workers pick strawberries by hand every three to five days throughout the harvest season, and sort them in the field for either fresh or frozen markets. Fresh market strawberries are placed directly in labeled, fiberboard trays and plastic containers. Strawberries for frozen markets are placed in bins for subsequent processing and packaging. California strawberries are harvested nearly year-round, with the earliest harvests commencing in the Southern California growing regions in January. Most berries harvested during this time are for the fresh market. As average daytime

temperatures rise, growing regions in Central and Northern California come into production. Peak production of California strawberries occurs in May and June, when statewide output reaches more than 9 million pounds a day (California Strawberry Commission 2003). Production generally decreases in September through October, with late harvests going primarily to frozen markets. In some Northern California growing regions, strawberries are harvested into November. Strawberries are planted as an annual crop, and following the first harvest season, plants are replaced with new nursery stock for the next season.

6.0 Emerging Trends and Demand Conditions

There are many emerging trends in the production and processing of California strawberries. Strawberry growers are now faced with strict regulations on the use and operation of pesticides. In addition to the development and use of new, highly specific, precision applied pesticides, California strawberry growers are embracing a pest control technique known as integrated pest management (IPM). A strawberry IPM program stresses the use of modified cultural practices, biological control using insect predators, and pest resistant strawberry varieties to combat damaging insect pests. IPM programs have greatly reduced total pesticide application by California strawberry growers.

California growers are also using new, higher quality varieties of strawberries. In addition to traditional Diamante and Camarosa varieties, which are grown on 65% of California's strawberry acreage, growers are now producing the Aroma variety. Released by the University of California breeding program in 1997, the Aroma is known for the bright sheen and excellent flavor of its large fruit. A number of cooperatives and processors have also established breeding programs to develop proprietary strawberry varieties. For example, Driscoll's Strawberry, a cooperative based in Watsonville, is currently conducting plant breeding trials to develop a berry with "improved flavor, appearance, and increased resistance to disease and pests (to reduce the need for pesticide)" (Driscoll's 2003). The result is "improved fruit, lower costs, and extended availability" (Driscoll's 2003).

The dynamic nature of the California strawberry subsector results from "one of the highest rates of consumption growth of all fruit and vegetable crops, with per capita consumption growing by 38 percent between 1990 and 2000" (Cook 2002). As California's total strawberry acreage proceeds to grow, and as harvest windows expand, greater supply and availability of fresh strawberries allow the subsector to meet an increasing demand for fresh strawberries. The overall trend toward eating more fresh fruit per capita in the U.S. has enhanced demand conditions for fresh strawberries. Another factor, specific to strawberries, has also had a positive impact on consumer demand. This relates to the trend of greater concern for health and nutrition among consumers. According to the California Strawberry Commission (2004b), strawberries provide significant amounts of the following nutrients: Fiber, potassium, antioxidants (including vitamin C), and folate. At the same time, strawberries have a lower amount of sugars per 140 g. serving than the following fruits: apples, grapes, bananas, and oranges. Strawberries are also a low fat food. Currently, nearly 94% of United States households consume strawberries (California Strawberry Commission 2003). According to recent research, strawberry consumers are generally individuals who earn \$75,000 or more annually, are college educated, and have large families with two or more children (California Strawberry Commission 2003).

7.0 Distribution, Pricing, and Promotional Methods

California strawberries can reach the consumer through a variety of channels. In some cases, strawberries may be sold directly to consumers at roadside stands and farmers markets. Most strawberries, however, proceed via refrigerated trucks to the cooling facilities of processors and shippers. Fresh strawberries are then shipped via cooled transport to markets and warehouses. Generally, fresh California strawberries can reach New York within four days of harvest (National Science Foundation Center for Integrated Pest Management 2003). Because strawberries are highly perishable, post harvest operations must maintain an ambient environment within narrow specifications to ensure high quality fruit and maximum shelf life. The required conditions are

temperatures of 34-36 F, 90 to 95% relative humidity, and high carbon dioxide concentrations (Post Harvest Technology Research and Information Center 2003).

Although the food service industry shows increasing interest in the use of California strawberries, the retail industry handles most of California's annual strawberry crop. These retailers are markets who purchase strawberries and then merchandise them to consumers. Studies suggest that 60% of strawberry purchases are impulse buys (California Strawberry Commission 2003). Consumer strawberry purchases are greatly influenced by price, promotion, appearance of display, packaging and product quality (California Strawberry Commission 2003). In the retail industry, the CSC's marketing practices are tailored to capitalize on these factors.

A key feature of any successful marketing mix is product price. The average price per pound of fresh strawberries varies throughout the harvest season. Generally, fresh California strawberries reach their highest average price of \$0.80 per pound in January through March, when supplies are limited (Goodhue and Jiang 2003). Prices hover near \$0.50 per pound from April until the end of the harvest season, as strawberries and other fresh fruit are readily available and must compete for shelf-space (Goodhue and Jiang 2003). Promotional strategies are also closely linked to the availability of fresh strawberries. Strawberry promotions are most common during the months of April and May, when fresh strawberry supplies are the greatest. As fresh strawberry production falls during the late summer and fall, promotions generally decrease (Goodhue and Jiang 2003). Price and promotion for frozen strawberries, however, are not significantly linked to harvest season as supply is consistent throughout the year.

Fresh strawberries have traditionally been sold most successfully in pint baskets. Fresh California strawberries are also sold in tray and half tray packages, consisting of twelve and six one-pint baskets, respectively. Baskets and trays are generally labeled by the packer or cooperative. A recent innovation is packing and marketing strawberries in large, plastic clamshell containers (Partida 2004). These packages are especially popular in major food retailers, such as, Costco and Wal-Mart. Frozen strawberries are usually available in bags or cans.

8.0 Evolving Marketing Strategies and Tactics

As consumer preferences continue to evolve, the California strawberry subsector must respond with a variety of innovative and successful marketing strategies. These strategies are usually concerned with packaging, strawberry quality and nutritional value, and promotion. Although fresh strawberries have traditionally been sold in pint baskets, one pound consumer packs now account for nearly 61% of peak season sales (California Strawberry Commission 2003). This novel approach to fresh strawberry packaging has allowed produce managers to market fresh strawberries more aggressively, resulting in increased sales (California Strawberry Commission 2003). A growing number of marketing strategies aim to increase sales through improved strawberry quality. As mentioned earlier, many growers are utilizing new and proprietary strawberry varieties to obtain fruit of better color, shape, flavor, and hardiness. Growers are also changing cultural practices to increase returns. One of the most promising markets for the California strawberry is based on the growing demand for organic produce. Nearly 2% of California's total strawberry acreage is certified organic (California Strawberry Commission 2003). An increasing demand for organic strawberries is expected to result in expanded organic strawberry acreage. In addition, a number of new, highly successful marketing programs highlight the great nutritional value of the California strawberry. (Nutritional characteristics were described in the demand conditions section above.)

To further promote their product, California strawberry subsector participants sponsor a number of consumer public relations programs. One popular activity is the celebration of annual strawberry festivals. For example, the Oxnard Strawberry Festival, held annually in May, attracts over 85,000 visitors each year. The festival includes pie eating contests, picking demonstrations, live entertainment, and of course, plenty of fresh strawberries (Library of Congress 2003).

The California Strawberry Commission also plays an important role in the promotion of California strawberries. Recently, the CSC joined Walt Disney World to offer "culinary workshops" intended to "demonstrate the endless usage opportunities,

versatility and menu-ing potential of California strawberries" (California Strawberry Commission 2003). The CSC has also worked with the United States Olympic teams to promote California strawberries. At the 2002 Olympic Winter Games, "California Strawberry Energizers" (smoothies made of strawberries and yogurt) were prepared as the official breakfast of the U.S. Ski and Snowboard team (California Strawberry Commission 2003). Most recently, the CSC has promoted California strawberries through donations to Marine forces based in Camp Lejeune, North Carolina. Rodger Wasson, President of the CSC, notes that the donations are "a tremendous reflection of the California strawberry industry's interest in supporting our troops and their families... We know one soldier, rescued POW Jessica Lynch, loves strawberries... and we hope these soldiers and their families will enjoy them too" (California Strawberry Commission 2003).

The CSC is involved in another promotional program taking place in May, 2004. Specifically, the International Health, Racquet, and Sportsclubs Association has organized a fitness campaign called Get Active America! This campaign entails, in part, more than 1,600 fitness clubs opening their doors to the public, allowing them three days of free access to their facilities. The CSC is one of two premier consumer sponsors of the campaign. According the International Health, Racquet, and Sportsclubs Association (2004), "Americans will also receive strawberry nutrition education during Get Active America! through the distribution of brochures and California Strawberry Commission's healthy recipes." The examples cited above (i.e., strawberry festivals, culinary workshops, product donations, and sponsorship of events), while not an exhaustive list of strawberry promotions, serve to illustrate the breath of promotional and public relations activities subsector participants perform.

9.0 Challenges and Responses

The California strawberry subsector will certainly face a number of challenges in the coming years. Perhaps the most critical of these challenges will be the loss of the fumigant methyl bromide. Methyl bromide is widely used by California strawberry

growers to fumigate soil prior to planting. Unfortunately, methyl bromide is also a known ozone depleter. According to the Federal Clean Air Act, strawberry growers must effectively discontinue the use of methyl bromide by January 1, 2005 (California Department of Pesticide Regulation 2003). Many California strawberry growers, faced with reduced yields in the absence of methyl bromide, are searching for replacements for the highly effective fumigant. The most popular replacement, a combination of 1,3-D and chloropicrin, shows promise, although the California Department of Pesticide Regulation is still researching application rates and techniques (Trout 2003). Many California strawberry growers remain optimistic about post methyl bromide strawberry production. According to Cook (2002), "some growers have already eliminated methyl bromide without reducing yields and assert that if methyl bromide is indeed lost, it will just mean that growers have less ability to produce on marginal ground, a flexibility which methyl bromide afforded."

This versatility and adaptability reflects an important factor for the success of the California strawberry subsector. As Oxnard strawberry grower David Murray explains, "You can never be ready for all the difficult challenges you will face. No matter how many years of experience you have, something is always changing... the more able you are to adapt to change, the more successful you will be in the long run" (California Strawberry Commission 2003). Irvine grower A.G. Kawamura would probably agree, but he also stresses the need for a marketing orientation: "Don't grow something just because you think you can grow it. Recognize that it is one thing to grow it and another thing to harvest, handle, transport and sell it" (California Strawberry Commission 2003).

Finn (2002) notes two other challenges facing the California strawberry subsector. One of these challenges is "urbanization, leading to loss of acreage and ability to farm and to increased cost of production" p. 111. This force will probably cause a shift in production area away from the southern part of the state. The other challenge relates to environmental concerns, both with plasticulture and regarding water quality. These concerns are being addressed by researchers in the state, and will require a sustained effort to develop an appropriate response.

10.0 Conclusions

This research addressed the major factors affecting the competitiveness of the California strawberry subsector, which is the dominant producer in North America. The basis of its competitive advantage is the set of agro-ecological resources that exists in California. As mentioned above, these include the state's unique coastal environment - hot, sunny days and cold, foggy nights (generated by the Pacific Ocean). These conditions facilitated the establishment of a very large production industry, with (nearly) year-round production capabilities.

The size of the subsector serves to reinforce its dominance at the continental level. The economies of size enjoyed by this industry arise from the ability to spread out fixed cost over greater volumes of output. The California strawberry production industry also is able to attract an adequate supply of picking labor, due to its size and length of season. It should also be noted that California is subject to lower labor costs than Oregon (Finn 2002), and that the Louisiana strawberry production industry is having difficulty obtaining the quality and quantity of labor it needs (Hinson and Bruchhaus 2004). Further, California has better access to Mexican agricultural laborers, compared to Florida.² The subsector is also able to sustain a commodity organization, the CSC, which is large enough to provide effective support in the areas of research, education, and promotion. The size of the subsector also provides the growers with marketing options, i.e., the fresh or the frozen market. This advantage is analogous to Idaho's position in the potato industry. Idaho potato growers have a full range of marketing options that allow them to receive the best possible price for their products.

The size of the subsector helps it to maintain its dominance versus other states, but this begs the question of how the subsector achieved its massive scope. According to Finn (2002), it was not until 1973 until California surpassed Oregon in strawberry acreage. Since then, the number of hectares planted to strawberries in Pacific coast states

² There are three traditional points where Mexican agricultural workers cross into the U.S.: California, Arizona, and Texas. Thus, workers who pick strawberries can enter directly into California, while their counterparts in the Florida industry must travel approximately 1,000 miles from Texas (Hinton).

has increased by more than 50%. California has accounted for all of this increase and more, because strawberry acreage in Oregon and Washington declined over this period. We credit this increase to the incredible yield advantage enjoyed by California growers. This yield advantage is a result of two factors, one of which (agro-ecological conditions) was addressed previously. The other factor is technology. California agricultural producers in general are noted for their progressive nature in terms of innovation and technology adoption, and this applies to California strawberry producers as well. The massive expansion of the strawberry production industry in the state allowed growers to adopt the most efficient and effective technology available, irrespective of past practices. This can be viewed as an example of second-mover advantage, like the one experienced by the Japanese steel industry.

The expansion of the California strawberry subsector could not have occurred without a corresponding increase in demand for the product. In fact, favorable demand conditions could be viewed as a key factor in the development of the subsector. Factors that have enhanced demand conditions for fresh strawberries (i.e., greater per capita consumption of fresh fruit, concern for health and nutrition, and positive nutritional features of strawberries) were discussed above.

While the California strawberry subsector faces some significant challenges, its future prospects are favorable. It will likely continue to dominate North American production due primarily to superior agro-ecological conditions, economies of size, support infrastructure, marketing flexibility, technological innovation, and favorable demand conditions.

11.0 Managerial Implications

This research has strategic implications for other geographic production areas. The basic implication is that producers or their representatives should seek out a commodity for which the agro-ecological conditions in their area are sufficiently favorable to provide a competitive advantage. Those commodities that can be supplied on a year-round basis and those that are expected to grow in per capita consumption

provide a special opportunity for the subsector to achieve significant growth, or even a dominant strategic position. Once growers or their representatives identify a suitable commodity, they should make efforts to develop an effective and efficient support infrastructure. In particular, they should emphasize developing an active research program and the capacity to engage in promotion and education.

Finally, having a local processing industry that includes several firms benefits the agricultural production industry and the subsector as a whole. This implies that growers or their representatives should identify potential processing firms and endeavor to attract them to their respective states. They should also make efforts to assure the retention and expansion of currently operating, local processing firms.

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