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CORNELL
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STAFF PAPER

**Pesticide Use and Produce Quality:
Evaluating the Role of Private Sector
Institutions**

by

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PESTICIDE USE AND PRODUCE QUALITY: EVALUATING THE ROLE OF PRIVATE SECTOR INSTITUTIONS*

Enrique E. Figueroa**

"The consumer seeks more fresh or fresh-like product of good visual quality that is full-flavored, nutritious, convenient to prepare and serve, pesticide-free, and available year round at a reasonable price. At the current state of the art, some of these goals are mutually exclusive, and the marketplace will decide which goals will predominate " (Shewfelt, p.105).

INTRODUCTION

The above quote appeared in 1990 and has particular relevance to the development of this paper. It serves to identify produce attributes upon which consumers base their purchasing decisions and postulates the, "...mutually exclusive...", nature of some attributes. Are the attributes mutually exclusive? Will the market place decide which attributes predominate? Can/should government intervention play a role or should the 'weeding' of the incompatible attributes be left entirely to the private sector? This paper will put forth a framework by which public and private sector individuals can evaluate the attribute culling process, if a culling process is warranted.

Before proceeding, it is important to identify a term frequently used when discussing the issue of produce quality and pesticide use. The term is "cosmetic" and is usually used in the context of cosmetic defects on produce. The term gained prominence because the 1990 Farm Bill passed by Congress specifically uses it in directing the USDA to investigate the above mentioned relationship. However, there appears to be no consensus on what cosmetic means--i.e. at what point does a 'blemish' cease to be a blemish and becomes a 'rot'? Can USDA 'condition' grade standards be evaluated to ascertain which constitute a cosmetically based condition? Should USDA grade standards be the vehicles for evaluating cosmetic standards in produce? How does the produce industry--from producer to consumer--arrive at a consensus of what is meant by cosmetic

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standards? A need does exist to define what is meant by cosmetic standards, particularly how the definition will serve to answer the preceding questions. So far, no consensus has emerged to define cosmetic standards and a number of professionals now argue that the term is inappropriate and should not be used.

Historically, the quality of produce has been ascertained by members of the trade through the use of USDA grade standards, label identification, and personal contacts and/or reputation. Consumers principally judge quality through appearance and the reputation and/or experience of shopping at a particular store. For the most part, both trade personnel and consumers have a consistent set of produce attributes that constitute quality. However, the use or non-use of pesticides in the production and distribution of produce is an area where trade personnel and consumers diverge in their relative assessments of quality. Those consumers that discount produce quality because it has or was produced with the use of pesticides generally are at odds with trade personnel who generally do not discount quality because of pesticide use. It is perhaps this divergence of quality assessment by these two market participants that is at the crux of the issue of produce quality and pesticide use.

DIMENSIONS OF THE ISSUE

The role private institutions play in determining a consensus on produce quality and pesticide use needs to be incorporated into and thereafter evaluated from a multi-dimensional perspective. The dimensions and key questions include:

- How do regulatory dimensions affect pesticide use and produce quality?**
- What is the appropriate framework for economic analysis of the issue?**
- What role do consumer preferences play?**
- What role does information transmitted by the market play?**
- What are the social welfare gains?**

A brief discussion follows regarding the possible answer(s) to the above questions, but more importantly the discussion attempts to frame the entire issue of pesticide use and produce quality from the perspective of the private sector.

Regulatory Environment

The regulatory environment for producing and marketing produce is primarily governed under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), the Federal Food, Drug, and Cosmetic Act (FFDCA), the Agricultural Marketing Agreement of 1937, and the Pesticide Monitoring Improvements Act of 1988 (U.S. General Accounting Office, December 1990). In addition, various states and/or market orders have other regulations specific to their jurisdictions. For example, the State of Maine has pesticide labeling requirements for produce containers. Also, California has very restrictive statutes governing pesticide use (Greene and Zepp, p.15). Given the multitude of current legislation on pesticide use, some form of new legislation would need to be introduced on how the definition of produce quality will incorporate pesticide use. Compounding the legislative debate will be issues raised by Dr. Bruce Ames at the University of California and his development of the "index for possible hazard," or HERP--human exposure/rodent potency index (Carter and Nuckton, p. 25). In short, Dr. Ames' perspective argues that commonly consumed items such as peanut butter and beer & wine pose more of a cancer threat than, say, DDT. Therefore, judgments about regulating pesticides need to have a balanced perspective and one that recognizes life's everyday hazards. To what extent private sector institutions are effective in forming the debate concerning regulatory issues affecting produce quality will be a function of how the industry and environmental groups can define risk and risk assessment of pesticides on produce. Indeed, agreeing on the appropriate risk assessment methodology for evaluating produce quality and pesticide use will be difficult--for environmental groups and produce industry groups have very different positions on what the appropriate methodology should be.

Framework For Economic Analysis

As just mentioned, the evaluation of risk and risk assessment is a key parameter in formulating pesticide use policy. Incorporating risk into an economic analysis framework is just as important, but unfortunately the current body of literature does not provide a rich foundation for

conducting sound economic analyses. Research is particularly lacking in the area of how firms and/or industry can make a determination of their optimal allocation of resources in a 'risky' environment. On the demand side, the incorporation of, say, 'pesticide residue free' as an attribute of produce has more literature supporting the approach.

The analytical methodologies which have been (can be) used to evaluate pesticides in/on produce are:

- 1.) The Houthakker-Thiel Model**
- 2.) The Lancaster Model**
- 3.) The Consumer Goods Characteristic Model**
- 4.) The Willingness-To-Pay Approach**
- 5.) The Reputation Setting Model**
- 6.) Conjoint Analysis**
- 7.) Consumer and Producer Surplus Modeling**

The Houthakker-Thiel Model incorporates both quantities and qualities--i.e. pesticide residue free as an attribute--of goods in a utility function. The Lancaster Model defines goods in a utility function as a bundle of characteristics--one would be the level of pesticide residues on particular tomatoes. The Consumer Goods Characteristic Model is a variant of the Lancaster Model and defines goods as having both common and unique characteristics--no pesticide residues in a particular brand/label of lettuce, for example (Morse and Eastwood). Some form of the preceding three models can yield a hedonic price function and such a function can directly estimate the implicit price(s) of attributes--i.e. pesticide residue free. An application of the Lancaster Model to evaluate the effect of the "Alar Scare" on apple sales in the Metropolitan New York City area found that information about the scare had a significant impact (van Ravenswaay and Hoehn). An application of a hedonic price equation to estimate implicit prices for selected quality attributes of tomatoes found differences across months of the year and across tomato attributes. Of the four attributes estimated, color, damage, firmness, and size, damage was the only attribute significant in all three time periods evaluated (Jordan, et al).

The above mentioned models are applicable to varying degrees. However, if data could be obtained on quantities and prices of produce with varying levels of pesticide related attributes, then the hedonic price equation model can yield sound and possibly robust results. For private firms, this

approach would yield estimates of price, income, and cross-price elasticities of demand and therefore allow firms to make better decisions concerning pricing and item availability.

Consumer Preferences

Of the six dimensions listed, the consumer preference dimension is the most researched. Though most work falls under the general category of 'Food Safety', a good amount of work has been conducted to ascertain consumer preferences for produce quality and its relationship to pesticide use. The statistic that the U.S. uses 45% of all pesticide production on only 7% of the cultivated land in the world may be at the root of consumer concerns about pesticides in food (U.S. Environmental Protection Agency, p. 12). Also, there is evidence that the level of concern about pesticide use on produce has changed over time. In 1965, 41.5% of surveyed consumers indicated that a danger existed in eating fruits and vegetables that had been sprayed or dusted with pesticides. By 1984, the comparable percentage had changed to 71.1% (Sachs, et al, p. 103). Conversely, a study of male and female Black and non-Black consumers indicates males think today's food is safer. However, the majority of females believe today's food is less safe (Jordan and Elnagheeb, p. 20).

Much of the work in the area of produce quality and pesticide use has used willingness to pay approaches. The prevalence of the approach emanates from the fact that many (most) consumers have not purchased produce which was produced and marketed under varying levels of pesticide use. The other factor contributing to the popularity of the approach is that researchers have been interested in determining consumer trade-offs between pesticide use and the appearance of produce--i.e. surface defects and/or perceived damage. A large majority of shoppers in the Atlanta Metropolitan market indicated some concern about pesticide use in produce. However, 61.5% of the respondents were not willing to accept cosmetic damage or insect damage--88.4%--on the produce they purchase even though the majority were willing to pay 5% more for pesticide-free produce (Ott). Another study indicates that 56% of respondents are willing to pay 10% or more for pesticide-free tomatoes, but less than half are willing to purchase tomatoes with cosmetic

defects. In addition, respondents--43%--indicated that their buying behavior with respect to produce changed due to their concern about pesticides. Of the individuals that changed their purchase behavior, 41% buy more organic and/or chemical free produce, while 22% **stopped buying** produce (Weaver, et al). Lastly, demographic characteristics affect consumers willingness to pay for certified pesticide residue free produce. The characteristics that positively influence the willingness to pay are: if the consumer values the testing of produce, if the consumer expects to be financially better off in the future, and if the consumer is White (vs. Black). The negative influences are: if consumers are in the 36-60 age group category, have a college education, and have incomes less than \$35,000 (Misra, et al).

How the market place incorporates the above information on consumer preference for produce with varying degrees of pesticide use will determine the extent to which government intervention will be needed. If the market place provides a variety of produce that satisfies varying consumer needs, then the likelihood of government intervention is diminished. A key component of satisfying different consumers is the ability of the market to transmit information between all market participants.

Information Transmitted by the Market

The most likely choice for transmitting market information about the use of pesticides in the production and distribution of produce is through brands and/or labels. However, an impediment to this approach is the perceived notion by producers and retailers that labeling a produce item as pesticide residue free or organic connote that the other produce items without such labels may not be safe. Also, the ability of a producer to maintain label/brand integrity as it moves along the market channel may not be very secure--once the producer sells the produce he/she has lost control of it. Moreover, consumers seem to have a relatively low level of confidence on the food industry for supplying information on food safety (Kramer and Penner, p.24). Nonetheless, the market place has and continues to support various forms of branding/labeling with respect to pesticides. A key question is the extent to which labels/brands can segment or differentiate produce

based on the level of pesticides used in its production and distribution.

The debate on whether USDA produce grade standards can/should be changed to incorporate information about pesticide use is perhaps a response to the inability of the current marketing system to transmit such information. The debate is useful in that various alternatives have surfaced--change standards; amend current grades; or a re-definition of what grade standards should provide to the market place (Armbruster). In addition, the debate and future research needs to consider:

- A.) Who derives information from grade standards?**
- B.) Have grade standards adapted to increased trade?**
- C.) What is the relationship between "information demand and "consumer demand"?"**
- D.) Can a consensus be generated on a new set of grade standards?**

The importance of the transmission of information by the market cannot be overemphasized and a number of researchers have specifically looked at this issue. One effort found very significant changes in consumers' willingness to buy oranges with thrip damage after they were told that the thrip damaged oranges were produced with half the pesticides of conventionally produced oranges (Lynch). Another study found that information plays a significant role in the outcome from the model. Consumers stated preferences for willingness to pay and/or buy produce with labels such as; organically grown, certified organically grown, pesticide residue tested, and IPM grown were a function of how well informed consumers were about the meaning of such labels (Underhill and Figueroa). In fact, the role information plays in determining the outcome of a particular form of analysis is critical, particularly in willingness to pay approaches. An extensive survey of shoppers in food stores in North Carolina found that shoppers did respond to information about the level of health risk associated with pesticide residues on produce. In addition, the information affect was a function of the amount of information shoppers had about produce prices (Eom). Information can have both supply-side and demand-side effects. On the demand-side, the effect of information on consumer demand is a function of; a.) information search; b.) knowledge; and c.) quality of choice (Price, et al). Lastly, an application of conjoint analysis found that the order of how respondents viewed pictures of bibb lettuce with varying levels of price, packaging, and pesticide-free labels

influenced their response (Stevenson).

The author is unaware of studies investigating industry-wide affects of produce labels/brands. However, a model developed to evaluate quality reputation appears to be an appropriate vehicle for analyzing the impact of the reputation of produce labels/brands on firm and market performance (Shapiro).

Welfare Gains

Though this is the most appropriate model for evaluating gains and losses by society, the lack of data renders the approach empirically inoperable. However, from a purely theoretical perspective, one study indicates that minimum quality standards which are discernible to consumers upon inspection cannot increase social welfare (Bockstael). Another puts forth the notion (counter-intuitive, perhaps) that producers could actually gain from pesticide restrictions if output product prices increase enough (Abler). Also, economy-wide effects concerning pesticide use are invariably based on information supplied by the scientific community and their track record appears to overestimate both the risks and benefits from pesticide use (Harper).

The preceding discussion on the dimensions of produce quality and pesticides use also needs to be couched within the existing produce marketing system. The section that follows will attempt to describe the produce marketing system and its ability to provide information about pesticide use and produce quality.

THE PRODUCE MARKETING SYSTEM

First, it is imperative that industry representatives and consumer voices be heard in the debate of pesticide use and produce quality. All market participants can gain if the market truly reflects the needs of participants, but all participants can lose if discord and suspicion dominate the debate. Before proceeding, the market system needs to be identified and the following is a simplistic depiction of the produce marketing industry.

Producers

----Industry organizations/associations
 ----Market order commission representatives
 ----Board members of cooperative
 ----Private firms

Retailers

----Supermarkets
 ----Independent grocery stores
 ----Health food stores
 ----Direct market sales

Market intermediaries

----Brokers
 ----Receivers
 ----Wholesalers
 ----Commission merchants

Consumers

----Consumer organizations
 ----Environmental groups
 ----Foodservice establishments
 ----Individuals

An important issue to producers is the availability and cost of pesticides. The process of pesticide registration is costly. The cost can be as high as \$25 million (American Council for Science and Health, pp. 23-25). Another estimate is \$40 to \$60 million (Council for Agricultural Sciences and Technology, pp. 8-9). More importantly, the Environmental Protection Agency (EPA) is reviewing a number of key pesticides for fruit and vegetable producers and a possible outcome is the removal of some pesticides from the market. A critical issue in the re-registration process is the EPA's policy of "acceptable risk"--one additional cancer per one million population. Also, the debate concerning the EPA's policy of using "economic benefits to farmers" as part of its evaluation process has been heated and may likely change (League of Women Voters Educational Fund, pp. 6-9).

Another aspect of the debate is the relationship between commodity programs such as market orders or set-aside programs. Unfortunately, relatively little work has been done looking at the direct link between grade and size provisions of market orders and the use of pesticides to meet such provisions. However, there is some evidence that provisions of the Florida market order for tomatoes grades are not consistent with consumer preferences for quality (Sun and Conklin). An effort that looked specifically at the impact of changing U.S. grain sector policy found that pesticide use would decline after implementing various policies. Also, output product price would increase and input prices would decline (Helmert and Azzan).

A number of questions will remain unanswered if and when some pesticides are removed from the market. For example, will pesticide manufacturers stop production of certain pesticides? Is there any level of oncogenic risk from pesticides that is acceptable? Will consumers accept more

blemishes on produce in order to have fewer pesticides applied (Gianessi and Greene)? Lastly, producer decisions on applying pesticides have and need to continue to incorporate considerations about the safety of farm workers (Schaub, p. 2).

Market intermediaries and retailers probably derive the greatest benefits from the current information transmitted through USDA produce grade standards. Conversely, one could argue that these two entities stand to lose the most if the grade standards are changed. Market intermediaries and retail produce buyers play a very important role in determining the type of produce attributes demanded in the market. Even though most would argue that the consumer ultimately decides what produce attributes the market will supply, other decisions by market intermediaries and retailers can play as large or larger role. For example, a wholesaler's decision on buying full or mixed loads from a distance supplier may likely be a function of transportation costs, the relative perishability & compatibility of the items in the mixed load, the prior or future 'deals' cut between the wholesaler and supplier, whether the supplier is willing to provide volume discounts, the shelf-life left in the produce items when the wholesaler receives it, and other factors not entirely related to consumer preferences. The retail produce buyer generally operates in a climate which requires particular levels of sales and profits over a specified time period. Again, the produce buyer's decision to carry items and/or allocate more or less shelf space incorporates factors such as: what the competition is doing; what items are or will be on ad; whether a produce item is short or long a particular week; prior or future 'deals' cut with produce suppliers; how to display a particular produce item--i.e. end-of-isle; or promotions sponsored by commodity organizations. In fact, organic produce suppliers argue that retail produce buyers have curtailed the expansion of the market by their merchandising and space allocation decisions concerning the display of organic produce.

Conversely, retailers who initially were advertising pesticide residue free produce no longer do so because of potential liabilities from 'truth in advertising' statutes. Also, retailers state that organic produce costs more than what their average shoppers are willing to pay for it and therefore it is not a profitable item for retailers to carry. Since large supermarket retailers now by-pass market intermediaries and buy directly from produce shippers, the role of market intermediaries is

more important in the small retail market channel. The small retailer market channel generally has higher prices for all items because volumes are smaller and overhead is higher. Therefore, carrying relatively higher priced produce--organics--is more difficult. The notion that organic produce is more expensive is not universally true, however.

There is no doubt that the current debate about produce quality and pesticide use is a result of efforts by environmental groups and consumer organizations. Their position at the table discussing pesticide use policy has up to now been vacant, but there will be no such vacancy in the future. A relatively silent entity has been the foodservice industry, but the potential for this industry to play a significant role in the debate between produce quality and pesticide use is large. A vehicle for change is the foodservice industry's practice of contracting with suppliers. In addition, the fact that foodservice firms generally represent large volume purchases adds clout to their ability to influence market outcomes. For example, a foodservice operator can require (some do already) from their suppliers that produce meet a particular level of pesticide use in the production and distribution of the produce. Because the relative cost of produce for a foodservice establishment is low, the firm can afford to pay a higher price for produce meeting pesticide use (non-use) requirements. From the supplier's perspective, entering a contract minimizes market risk and therefore he/she is more amenable to meet varying criteria for his/her produce. Demographic variables also contribute to the foodservice industry's ability to wield more market power in the future. More individuals are eating from menus prepared for larger and expanding populations--nursing homes, prisons, consolidation of school and municipal districts, more cafeterias at work sites and/or offices, etc. and therefore the director of foodservice for a chain of nursing homes represents a larger and expanding market.

Lastly, the trend in the consumption of produce continues to be upward and the primary reason for increased consumption is health/nutrition (The Packer, p. 16). The advent of the **5-A-Day-Program** will contribute to the trend and will most likely accelerate it. The current U.S. population is eating 3.4 servings per day of fruits and vegetables and therefore meeting the goal of **5-servings** represents an increase of 32% (Subar, et al, p.2).

SUMMATION

Private sector institutions will play a diminished role in the debate concerning produce quality and pesticide use. Indeed, the Clinton Administration has just announced a policy to reduce the amount of pesticides used in the production of food (The New York Times, front page). This is not to say that the private sector will play an insignificant role, but rather that the industry's share of the policy setting 'pie' will be smaller. However, the total market for produce has and will likely continue to increase and therefore the relative health of the industry is not in jeopardy. What is in jeopardy is the industry's ability to be the primary (sole) user and therefore the primary entity that will continue to define USDA produce grade standards. Along with the loss of being the 'primary user' of USDA grade standards, will be the loss of the responsible of being the sole payee for the USDA grade standards system. Consumers and other market participants will most likely have to bare some of the costs of changing USDA produce grade standards.

It is not a foregone conclusion that USDA grade standards need changing, but what is clear is that some system needs to be implemented that transmits pesticide use and produce quality information through the marketing channel(s). Since current grade standards serve the function of transmitting produce quality information along the marketing channel, then many market participants, particularly consumers, feel it is also the appropriate vehicle for transmitting information on pesticide use. However, before embarking on such a course, research needs to be conducted on what is meant by "cosmetic standards" and the appropriateness of the current grade system to inform all market participants of such standards. More specifically, future research on the relationship between pesticide use and cosmetic standards needs to ask the following:

- 1.) To what extent do cosmetic standards lead to greater/lesser food contamination?
- 2.) How, if at all, do cosmetic standards increase human poisoning?
- 3.) To what extent do cosmetic standards contribute to environmental pollution?
- 4.) To what extent do cosmetic standards increase energy use in produce production?
- 5.) To what extent do cosmetic standards in/decrease produce costs to consumers (Pimentel, *et al*)?

Two final points warrant identification for further research. The first is the relationship between the **5-A-Day-Program** and the ability of low income consumers to have sufficient funds to purchase 5-servings-a-day. Will the **5-A-Day-Program** increase demand to the point where produce prices increase significantly? This is a particularly relevant question if the EPA's re-registration process removes a number of pesticides from the market which results in decreased supply. The second point is related to the first. What level of future U.S. consumption of produce be produced outside the U.S.? The issue has particular relevance to pesticide use and produce quality because of the 'set' of pesticides available to foreign producers which may not be available to domestic producers. For example, if a particularly effective pesticide which breaks down quickly after use (i.e. not found on the actual produce at the time it is imported) is only available to foreign producers, then can domestic producers claim a competitive disadvantage? Or, will the imported produce help keep prices low and available to low income consumers?

The paper began with a quote and it concludes with another that identifies a potential vehicle for addressing the issue of produce quality and pesticide use. In fact, it reflects on changes that are already taking found in the market place.

"Brand labeling of fresh produce...may provide the necessary vehicle for changing consumer orientation from an emphasis on appearance to less pesticide use, particularly if the label can serve as a guarantor of consistently high consumption quality" (Shewfelt, p.105).

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