

QUALITY OF FARM PRODUCTS IMPLICATIONS FOR FARM PROFITABILITY

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QUALITY OF FARM PRODUCTS: IMPLICATIONS FOR FARM PROFITABILITY

Executive Summary

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Products sold by farmers generally are viewed as commodities with little quality variation. In certain instances, however, farm products do vary in quality, which affects product processing costs and end product desirability. Farmer-controlled quality increases have the potential to benefit both the farm and food manufacturing sectors.

Given that a quality increase will reduce food manufacturing costs or increase end product desirability, conditions necessary for a quality increase include:

- (1) a conducive market between the farm and food manufacturing sector,
- (2) farmer's revenues associated with the higher-quality product must exceed the costs of producing the higher-quality product.
- (3) food manufacturers must be able to "process" the higher-quality product.

Condition (1) is the most critical. It requires that clear market signals induce farmers to produce the higher-quality product. These market signals can be obtained through contractual agreements, component pricing, or premium structures. Moreover, adoption will be aided if all market participants understand the characteristics of and benefits associated with the higher-quality product.

If past experience is an indicator, meeting condition (2) presents relatively few problems. Production of a higher-quality product has been associated with little increase, and even decreases, in farmer costs. First, for example, production of undamaged grain free of foreign matter requires proper harvest equipment setup, which is inexpensive. Second, milk containing low plate counts increases cheese yield. Plate counts can be lowered by controlling mastitis. Many studies show that controlling mastitis actually decreases a farmer's average costs of milk production.

Food manufacturers must have the ability to process the higher-quality product -- condition (3). In many cases, the constraint is the ability to separate higher from lower-quality product. For example, milk processors generally blend milk from many different farms. This reduces the advantages of having higher-quality milk from one farm while not having higher-quality milk from another.

Gains from quality increases will be distributed between the farm and food manufacturing sectors. The exact nature of distribution is unknown; however, neither sector should lose. Because potential for pure economic profits exists, more benefits will accrue to early producers of higher-quality products. As additional farmers and food manufactures produce the higher-quality product pure profits will approach zero. This does not mean, however, that long-run income will not be enhanced. Income may be enhanced if producing the higher-quality product requires higher levels of management of other non-purchased inputs.

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Products sold by farmers generally are viewed as commodities with little quality variance. However, farm products do vary in grade, which affects product processing costs and overall desirability of end products. Farmer-controlled product enhancements have the potential to benefit farmers and food manufacturers. Moreover, quality increases will benefit consumers of agricultural products.

A quality increase is defined as any change in the characteristics of a farm product which enhances the desirability of that product. Generally, product desirability is increased by one of two ways. First, a quality increase may reduce food manufacturing costs by increasing manufacturing productivity. For example, milk with low plate counts increases the amount of cheese derived from a given volume of milk, thereby reducing food manufacturing costs. Second, a quality increase enhances the desirability of the end product received by consumers. For instance, export customers prefer grains with few damaged kernels, and free from foreign material.

This paper is an analysis of potential benefits of farm product quality increases. The following section develops a conceptual framework for quality increase analysis. From this development, potential benefits are forecast and developmental conditions of the quality increase are outlined. The second section discusses market characteristics which may facilitate quality increases. Finally, examples of quality increases are presented.

Conceptual Framework for Analyzing Quality Increases

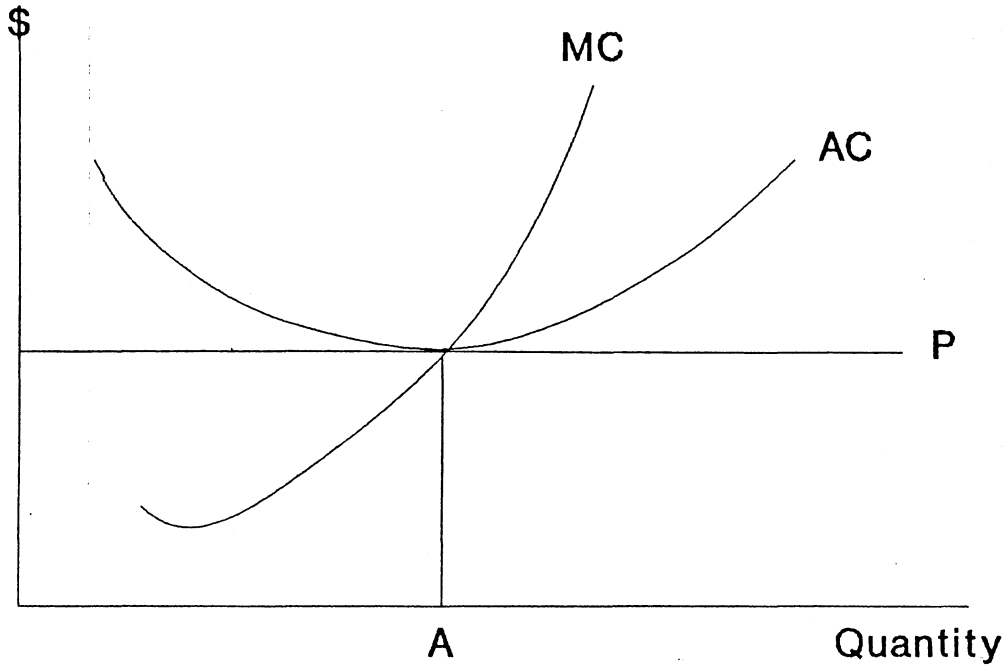
Gains from quality increases are analyzed using a multi-market framework similar to that developed by Just and Hueth (1). These authors use this framework to analyze the welfare benefits of various technological changes in the farm sector. In the interest of simplicity, technical details and mathematical derivations associated with this framework have not been presented. Instead, a graphical approach is used to illustrate general principles and indicate directions of profitability and income changes.

When analyzing a quality increase, producers and consumers of agricultural products are divided into three sectors: farm, food manufacturing, and consumer. The farm sector consists of firms that produce raw agricultural products. Next, food manufacturing firms process farm products into consumer goods. Functions of the food manufacturing sector include transportation, manufacturing, packaging, and marketing. Finally, consumers are the users of the agricultural end product. Economics linkages between each sector are competitive, so a firm can not affect the price of the product to the consumer.

The Farm Sector

Farms benefit from quality increases when the additional revenue from the higher quality product initially exceeds the additional costs of producing the higher quality product. Figure 1 shows price and cost

Panel A. Before the Quality Increase.



Panel B. Before and After the Quality Increase.

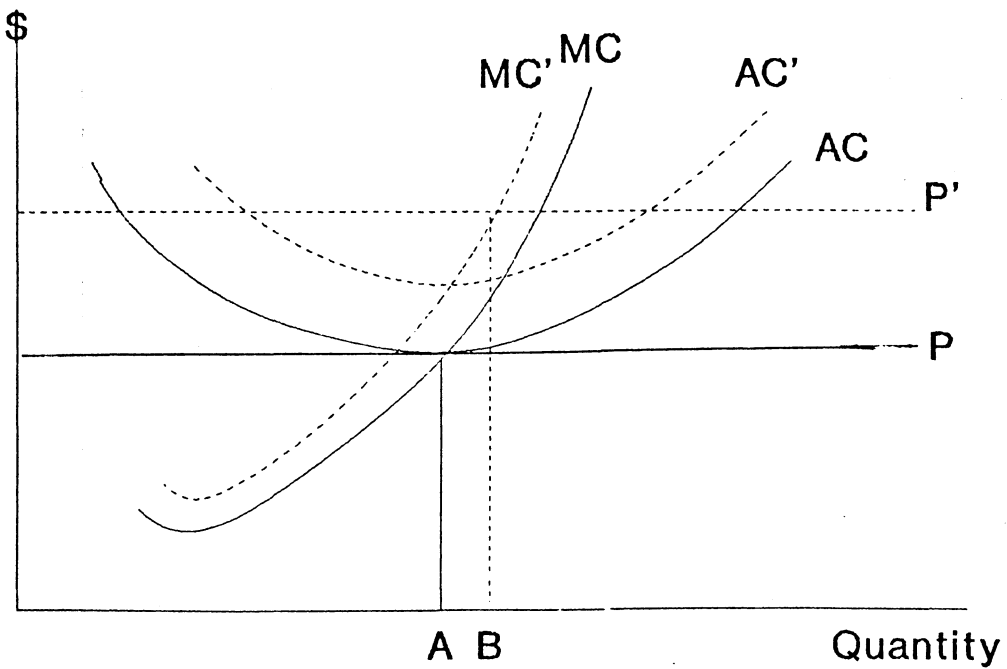


Figure 1. A Quality Increase Effects on a Farm's Price and Cost Curves.

increase. In both panels, dollars are indicated on the vertical axes. The horizontal axes indicate the differing levels of product sold by a farmer.

The P, AC, and MC curves in Panel A respectively show product price, average cost, and marginal cost curves for a farm. The P curve gives the price a farmer receives for the product. Since the sector is competitive, price does not vary with an individual firm's output. Therefore, the price curve is horizontal. The AC curve gives the average production cost of a unit at differing output levels. Finally, the MC curve illustrates changes in production costs.

Given the construction of the curves, output occurs where price equals marginal cost (Point A). This point represents a long-run equilibrium because price equals average cost and marginal cost. However, profit is non-existent, as it is indicated by a positive difference between price and average cost.

Although profits equal zero, income is greater than zero. Profits equal revenues minus paid costs (variable and fixed), less opportunity charges for unpaid factors. Unpaid factors include operator labor, operator management, and operator capital. When profits exist, resources flow into a sector until profits equal zero. Conversely, losses (negative profits) cause resources to flow out of a sector until profits rise to zero. Income is revenue minus paid variable and fixed costs. It includes profits plus opportunity costs for unpaid factors of production. Therefore, income always exceeds profit.

The solid lines in Panel B represent price and cost curves before the quality increase. Dashed lines show curves after the quality increase. For the higher-quality good, price P' is determined as $(P' - P)$ higher than the lower-quality item. Illustrated by the higher AC' and MC' curves, additional costs are incurred in production. Given the construction of the curves, output occurs at Point B. The incentive to produce the higher-quality product exists because price (P') exceeds average cost (AC').

All farmers will not benefit from these conditions. As with profits from technological changes, early adopters of quality increase will receive profits (2). Profits diminish as additional farmers gravitate toward higher-quality production. Farmers who adopt the quality increase at later stages will not gain profits, however, they will be forced to adopt the quality increase in order to stay competitive.

Several conditions occur once the quality increase has been adopted by the majority of farmers. First of all, price will equal average cost and marginal cost, indicating an absence of profits. Also, income may differ from its prior quality increase level. No guarantee can be assured of higher income (see 1, 3, and 4 for similar results under differing situations), except in specific situations, which will be discussed later.

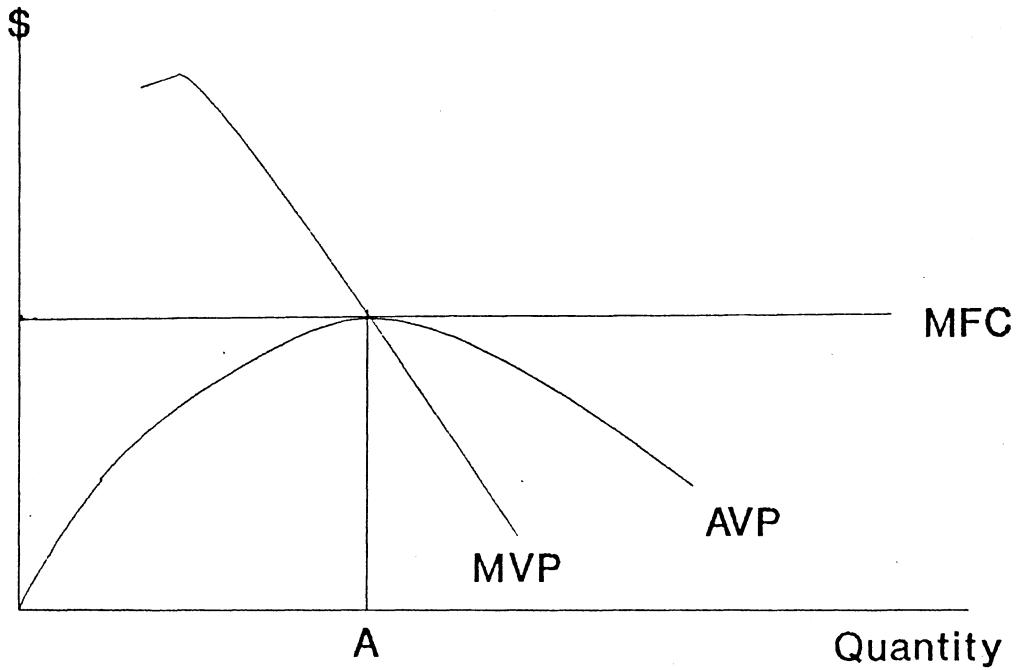
The Food Manufacturing Sector

Food manufacturing firms could benefit from a quality increase when higher quality product revenues exceed the costs of the higher quality production. Figure 2 shows value and cost curves illustrating such a situation for a single food manufacturing firm. Each panel's vertical axis represents dollars while the horizontal axis gives the quantity of the farm product used in the manufacturing process.

Panel A is the model prior to the quality change. In this case, the use amount of a given farm product occurs where marginal factor costs equals marginal value of product. This point is denoted as A. The MFC curve denotes the marginal factor cost of the farm product to the manufacturing firm. Given that the market between farmers and food manufacturers is competitive, the marginal factor cost equals the product price paid to farmers. Conceptually, it shows the changes in revenue for very small quantity variations of farm product use in the manufacturing process. The AVP curve gives the average value of product. The average value of product equals revenue received for the final product less the costs of other manufacturing factors divided by the quantity of farm products used in the manufacturing process.

As stated earlier, the quality increase will either 1) increase productivity of the food manufacturers or 2) increase the price of the final product. In either case, the result of the farm quality increase is higher average and marginal value of products (Panel B, Figure 2).

Panel A. Before the Quality Increase.



Panel B. Before and After the Quality Increase.

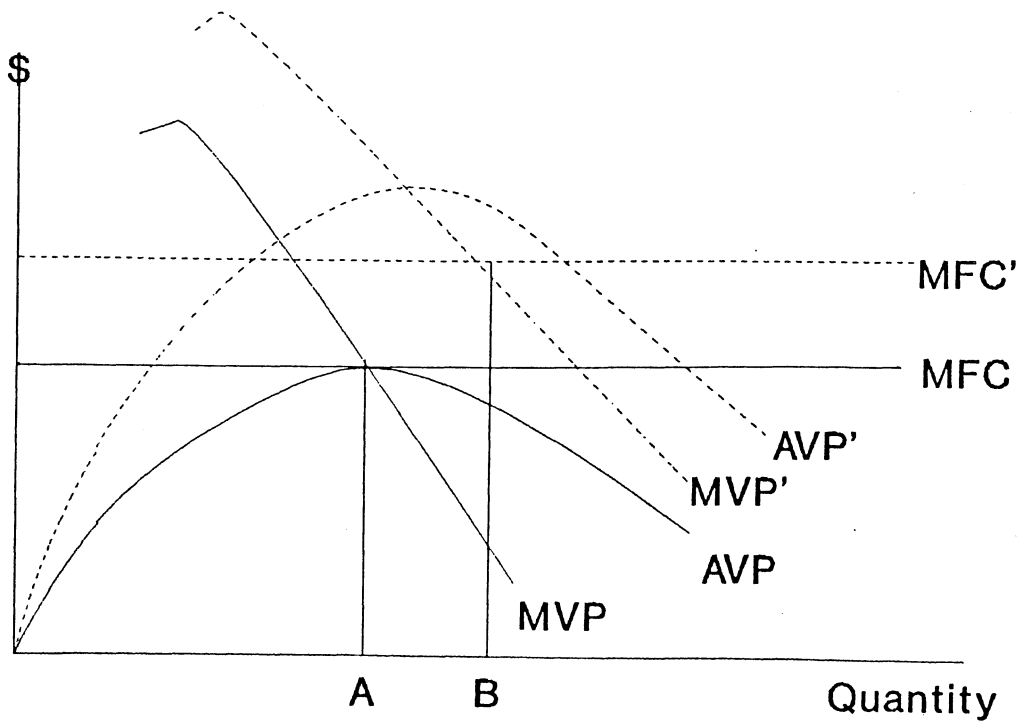


Figure 2. A Quality Increase Effects on a Food Manufacturing Firm's Price and Cost Curves.

The new average and marginal value of product curves are illustrated by dashed lines and respectively denoted as AVP' and MVP'. As constructed, the food manufacturer purchases point B level of the farm product.

At this point, profits will exist since average value of the product exceeds the marginal factor costs. However, as with the farm sector, the existence of profits is a short-term condition. Over time, food manufacturers will bid up the price of the farm product. Furthermore, greater quantities of the final product tend to be produced, which will lower both the average and marginal average value of product curves. In the long-run, production stabilizes where the marginal value of product equals average value of product plus marginal factor cost. Profit is not existent at this stage. Finally, like the farm sector, income may have increased, decreased, or remained the same following adoption of the quality change.

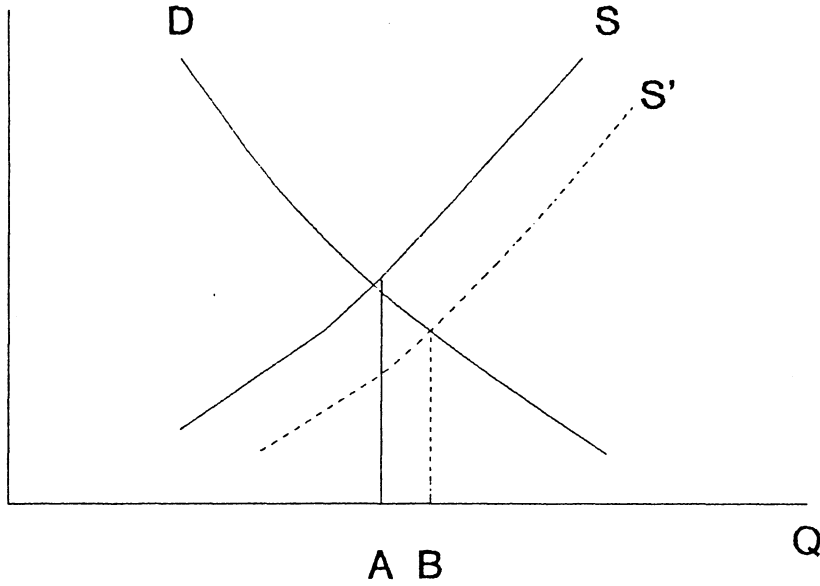
The Consumer Sector

Implementation of a farm quality increase always benefits the consumer sector. The nature of the benefit depends on two factors: whether the quality change reduces the food manufacturers' costs, and/or if it enhances the desirability of the final product to the consumer.

Panel A of Figure 3 delineates the supply and demand situation when the quality increase reduces manufacturing costs. The vertical axis represents price of the final product, and the horizontal axis the amount produced of the final consumer product. The solid, upward-

Panel A. A Quality Increase Reducing Manufacturing Costs

Price



Panel B. A Quality Increase Increasing End Product Desirability.

Price

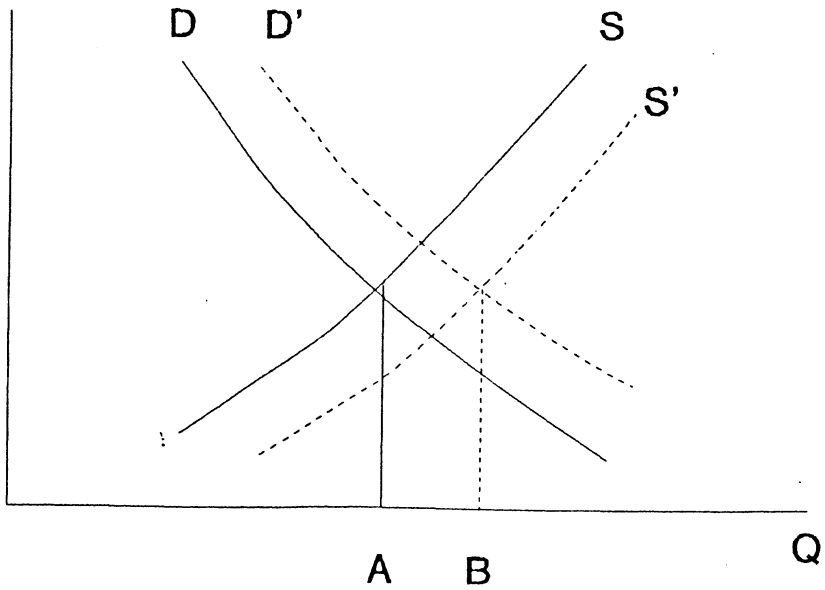


Figure 3. A Quality Increase Effects on the Supply and Demand of Food Products.

sloping supply curve (S) shows the product quantity supplied at various prices. The downward sloping demand curve suggests the price consumers are willing to pay for differing quantities of the final product. The long-run effect of a quality increase that reduces food manufacturing costs is a shift of the supply curve down, as illustrated by the dashed supply curve (S'). Consumers benefit from this condition because they receive a larger quantity of goods at a lower price.¹

Panel B represents conditions where the quality increase enhances the desirability of the product to the consumer. Theoretically, enhanced quality will increase consumer willingness to pay a higher price for the same amount of goods. This enhancement is represented by the outward shift of the demand curve from the solid to the dashed line. The supply curve also may shift if additional costs are incurred during production. This is represented by the movement from the solid curve to the dashed curve. As with a quality increase which lowers food manufacturing costs, consumers always benefit from the quality increase.

Long-run income to the farm and food sector may not vary as a result of the quality increase.² However, because quality increases tend to require more management, farmer's and food manufacturer's income will likely increase. Usually, income increases as more management is required.

A unique situation guarantees higher income as a result of a quality increase. This occurs when the farmer's production costs for

¹ The aggregate benefit is measured by consumer surplus, the area between the demand curve and the final price (1).

² Income to the farm and food manufacturing sector is measured by producer surplus (1).

the higher quality product are equal to or less than those of producing the lower quality product.

Summary of the Results from the Conceptual Model

The value of quality increase goods is summarized below:

1. Consumers invariably benefit from a quality increase.
2. In the short-run, farmers and food manufactures who adopt a quality increase relatively early will benefit most, because early adopters garner profits.
3. Over time, profits resulting from the quality increase will equal zero.
4. Long-run enhanced income is not guaranteed. However, if the quality increase does not raise the farmer's total cost of production, income to the farm and food manufacturing sector will rise.

The following initial conditions must be met before a quality increase will occur:

1. A farmer's revenues associated with the higher-quality product must exceed the costs of producing the higher-quality product.
2. Food manufacturers must be able to use the higher-quality product either to reduce production costs or to enhance their final product.

Markets Conducive to Quality Changes

To meet the above conditions, a market must exist between farmers and food manufacturers which is conducive to quality increases. This market should reward farmers producing higher-quality products. One means of guaranteeing a reward is by placing a premium on the higher-quality product. Several market mechanisms may facilitate quality increases, such as contractual agreements, premium or discount structures, and component pricing

Contractual Arrangements: A contractual arrangement between a farmer and food manufacturer could specify the desired quality of an agricultural product. Furthermore, discounts could be written into the contract for products not meeting the desired quality. Contractual arrangements are usually inappropriate for farm products, but they do exist for vegetable crops (specifying the size, maximum foreign material, and maturity of the product), specialty crops such as popcorn (specifying the maximum amount of damaged kernels and foreign materials contained in the grain), and grains raised for seed (specifying the maximum amount of foreign material and damaged kernels in the grain).

Premium or Discount Structures: Under a premium or discount structure, a base price is paid for an agricultural commodity. In these cases, a premium may be added if the product exceeds the standard quality measure, or a discount charged if the product falls below specifications. Examples include discounts for grain with excessive

foreign matter or damaged kernels, and for milk having large plate counts. On the other hand, premiums might be paid for milk containing high protein levels.

Component Pricing: Component pricing is an industry-wide pricing basis. Based on specified measures of volume and components (5,6), a component pricing plan pays farmers and charges food manufacturers accordingly. If the component represents some measure of quality, it encourages quality increases. For instance, component pricing is currently under consideration for certain federal milk marketing orders. If adopted, such a plan would pay for higher levels of protein.

Examples of Potential Quality Increases

A troubling aspect of quality increases is the lack of a guaranteed long-run income enhancement. However, upon examination, past quality increases show relatively few additional costs to the farmer. These past low costs suggest that farmers and food manufacturers are likely to benefit from quality increases. Two products, grain and milk, have great potential for benefit from quality increase adoption, as delineated below.

Grain Quality: The quality of grain is enhanced by removal of foreign materials and damaged kernels. American grain is often criticized by importing countries for its poor quality (1). Farmers can produce "higher-quality" grain by proper use of harvesting machines and careful handling of the grain.

Milk Quality: As stated previously, milk having low plate counts is considered "higher quality." The amount of cheese and milk produced from a given volume of milk increases as plate counts decrease. By controlling mastitis, farmers can greatly reduce plate counts. Numerous studies indicate that controlling mastitis does not increase farmers' costs, but significantly reduces the cost of producing milk (7 and 8). Thus, this quality increase would result in long-run income enhancement to farmers.

Summary and Implications

Quality increases have the potential to benefit the entire spectrum, from farmers and food manufacturers to consumers. Certain conditions must be met for a quality increase to occur, including 1) the existence of a conducive market between farmers and food manufacturers, 2) farm revenue from the higher quality product must initially exceed additional costs of production, and 3) food manufacturer's additional revenue from the higher quality product must initially exceed food manufacturer's additional production costs.

In view of potential benefits, farmers and food manufactures should investigate increases. These investigations could take the form of consumer surveys to identify product characteristics that would enhance desirability and examination of production processes to determine which characteristics of the farm product increase manufacturing productivity. Once a potential quality increase has been identified, means of inducing the quality change, such as appropriate pricing structures, can be explored. Furthermore, communication between

farmers and food manufactures, which clarifies the desired characteristics of the farm product, is tantamount.

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