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with the management and employees in each store. In addition, each store's store success ratio was examined to reinforce the difference. Store A was determined to be the better managed store with a store success ratio of 1.02 followed by Store C and then Store B with store success ratios of .80 and .52 respectively. Store success ratio is defined as weekly average departmental or total store sales divided by the industry standard.

<sup>5</sup>Labor productivity was measured by labor expense as a percent of total store sales and industry standard data for this ratio.

#### REFERENCES

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## **LOSSES IN THE U.S. FOOD DISTRIBUTION SYSTEM: OVERVIEW AND SUMMARY**

by:

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### Introduction

This paper is one of several reports resulting from research contracted by the National Science Foundation - Research Applied to National Needs (NSF-RANN) to establish estimates of the general magnitudes and locations of "food losses" occurring in the food distribution system.<sup>1</sup> It presents a brief overview of the objectives and the procedures used, as well as summarized findings from the study. Due to the large size of the study and the broad spectrum of food marketing information collected and analyzed, only highlights of the results and their implica-

tions are provided in this report. The findings, in turn, illustrate several economic principles that must be considered in any discussion of "food loss" prevention or reduction. Finally, a number of requisite needs are identified which must be met before significant reductions in food losses can be attained on a systems-wide basis.

### The Study

"Food losses" is a term that is subject to many interpretations. The purposes and nature of this study dictated the use of a number of different "food

losses" terms and concepts: food losses by weight, economic value of physical food losses, total economic costs associated with food losses, shrinkage, and food losses resulting in reductions in either the quantity or quality of food available for human consumption. Although different "food loss" concepts were used, the study tended toward a single focus: an effort to develop estimates or proxies for the quantities of food lost for human consumption.

In order to accomplish this task within the framework of available resources, it initially was necessary to consider "food losses" in the broader contexts indicated above. Insofar as possible, this information has been honed and transformed, or allowances have been made, to arrive at estimates of the quantities of food lost for human consumption. In this case, losses of food available for human consumption refers to those food products commonly distributed through the contemporary U.S. marketing and distribution systems. Thus, food products which are customarily and purposely discarded were not included as losses even though potentially edible and nutritious. Examples of these kinds of losses include: blood and other animal products not normally consumed in our society, and certain parts of fruits and vegetables that are routinely trimmed and thrown away.

The study covered distribution activities ranging from the packer's, processor's, or manufacturer's shipping dock through transportation, wholesaling, and supermarket retailing operations. Clearly these operations vary sharply from one another, depending upon the product in question. For example, lettuce may be packed for shipping while still in the field, immediately after harvest. Thus, losses of lettuce are calculated from the time it leaves the field until consumers purchase it in supermarkets. On the other hand, frozen vegetable losses were figured from the time the product leaves the free-

zing plant or manufacturer's storage facility until consumers purchase it in supermarkets. In all cases, the distribution systems covered in the study were those ending with the supermarket. In most cases, they began with transportation to distribution centers or warehouses which service supermarkets. In essence, the vast majority of transportation, wholesaling, and supermarket retailing activities of food products were included for study.

In total, seven food product categories have been analyzed. These categories are fresh beef, produce, dairy products, dry grocery, frozen foods, bakery goods, and foods sold through delicatessen departments. Foods within these seven categories constitute about 92 percent of supermarket dollar food sales. Dry grocery is the largest category, accounting for about 36 percent of supermarket food sales. It is followed by dairy products at about 15 percent, fresh beef at about 13 percent, and produce at about 9.8 percent of food sales. Frozen foods, "deli" department foods, and bakery goods accounted for 8.1, 5.2, and 4.7 percent of supermarket food sales, respectively. It should be noted that with the exception of fresh beef, the categories are designated according to conventional food store departments. In the case of beef, it is the dominant product in the meat department.

It was indicated previously that this study is intended to provide basic background information on food losses during distribution. The foregoing concepts of food losses, types of distribution activities, and broad categories of food products were chosen for study to meet the overall objective. Additionally, however, there were a number of more specific objectives, several of which were common to all seven food product categories:

- To identify the general magnitudes and locations of major food losses

during distribution activities based upon a thorough inventory of available information.

- To determine the current approaches being used to control food losses and to access the strengths and weaknesses of these approaches.
- To identify areas of food losses research which may need greater emphasis in order to reduce losses.

Research procedures employed to meet the objectives involved a four-step process:

1. An initial, broad based survey of available published information was conducted. Sources of information included: (a) university, United States Department of Agriculture and private industry-sponsored research studies; (b) proceedings of university and industry-sponsored symposia on food losses and related topics; and (c) trade publications.
2. The use of a reactor panel composed of representatives from industry, trade association, and government organizations. The panel members commented on the preliminary findings and aided in the assembly of source materials beyond those used in the initial reports.
3. The reconstruction of selected published data to help develop the required breadth of information.
4. A limited number of in-depth interviews with selected industry authorities to provide additional information and to ascertain the reasonableness of findings.

#### Magnitudes of Food Losses

Table 1 provides aggregate food loss information covering all seven food product categories studied. A number of points of clarification regarding this information and its appropriate interpretation

may be useful. Although the percentage loss figures were collected in 1977 and 1978, they apply to a much broader time period and are believed to be representatives of loss rates occurring today.

The percentage losses are based upon dollar values of losses in each stage of distribution as a percentage of the wholesale value of products entering the distribution system. The value of losses during transportation and wholesaling activities are based upon wholesale prices, whereas, losses at retail are based upon retail prices. In all cases, the estimates apply only to food lost for human consumption. Costs of recoup, salvage operations, and numerous indirect costs associated with losses, even though they are assumed to be substantial, are not included.

For those who are familiar with supermarket retailing statistics, the product group proportions of supermarket food sales may appear unusually large. It should be noted that these are estimated percentages of supermarket food sales, and not total supermarket sales. This distinction arises because supermarkets increasingly sell large quantities of non-food items, although this trend is not uniform throughout the industry. In arriving at these figures, background data has been taken from the trade publication, Chain Store Age Supermarkets, "1978 Sales Manual," July 1978. Other sources for this type of aggregate data may lead to slightly different department sales figures, and thus, to slightly different aggregate loss figures.

The reader should be cautioned that the figures presented may imply a level of precision somewhat beyond what can be justified by the information base. In general, digits to the right of the decimal point have been retained for reasons of consistency rather than to indicate a level of precision. It is also important to realize several significant limitations

Table 1. Estimates of Food Losses During Distribution

Food Product Group	Losses	Product Group's Proportion of Super-Market Food Sales
	(percent)	(percent)
Fresh Beef	4.8	13.4
Produce	9.04 - 16.61	9.8
Dairy Products	.63 - 3.50	15.2
Dry Grocery	.382	36.2
Frozen Foods	.98 - 2.85	8.1
Bakery Goods	1.05 - 12.48	4.7
Deli Foods	4.91 - 7.40	5.2
TOTALS	1.77 - 3.60*	92.6

\*These figures are based upon a range of 1977 dollar losses--\$1,590 to \$3,234 billion--as a percentage of 1977 total supermarket food sales.

of the estimates. In some cases, the ranges of losses are very broad. These ranges reflect substantial variation in actual practices and performance being achieved by firms operating in the food distribution systems. Additionally, the informational bases used to develop the ranges are too limited to assume average losses at the center of each range. Thus, representative averages cannot be determined from the ranges presented in Table 1. In the case of dry grocery and fresh beef losses, point estimates could be developed due to the availability of more broadly based information.

\* With regard to the specific findings, several points stand out. Overall, while the aggregate dollar values of losses during distribution are very large, about \$1.6 to \$3.2 billion, on a percentage basis they tend to be relatively small--ranging from about 1.8 to 3.6 percent of all food moving through the supermarket

distribution channels. These percentages, as well as the dollar ranges, seem to be of similar magnitudes to those reported by other industry observers. In both percentage and dollar value terms, the most serious food loss problems exist in the fresh beef and produce areas. This is especially true when contrasted with the dry grocery category. In terms of the 1977 dollar values, losses are: fresh beef (\$510 million), produce (\$640-\$1262 million), and dry groceries (\$114 million). Clearly, dry grocery losses as a percentage of movement are very low; although the category is such a large portion of supermarket food sales that the aggregate value of losses is a substantial figure.

The aggregate figures showing the range of dollar food losses are enormous. While such data may serve a useful purpose, they may also lead to the assumption of extreme and perhaps even willful

wastefulness. This is generally not correct. It must be recognized that these highly aggregated estimates do not reflect the temporal and spatial dimensions over which losses take place. Neither are the magnitudes of individual incidents of losses conveyed in such data. Indeed, there are hundreds of thousands of trucks, thousands of food processing plants and distribution centers, and over 33 thousand supermarkets, all of which are the sites of individual losses--24 hours a day, 365 days per year. Moreover, the vast majority of individual loss incidents tend to be relatively small, frequently being measured in cents rather than dollars. Thus, aggregate dollar values of food losses are not sufficient measures of the economic incentive for food loss reduction activities, and may encourage misguided suggestions for loss reduction activities.

however, aggregate data on the magnitude of food losses may serve a useful purpose if they generate industry and public awareness of this important issue. Food loss quantities and costs, as large as they are, have the capacity to impress, if not shock readers. Some industry executives contacted during the study were surprised to learn the accumulated costs of food and related losses in their operations. Indeed, some indicated that loss reduction behavior would be motivated by increasing management and employee awareness of the problem.

#### Causes of Food Losses

Damaged merchandise, encountered in supermarkets as cartons are opened for shelf stocking and display, constitutes a large portion of losses occurring during distribution. In many instances, there is little evidence to indicate whether the produce was actually damaged while in the supermarket, in transit to the supermarket, at the wholesaler's distribution center, in the food processing plant, during assembly after harvest, or at the time of harvest. Thus, exact locations

and specific causes for individual food losses in the food system are often unknown. This uncertainty regarding the locations and causes of food losses contributes to the limitations of aggregate data. One reason for the relative absence of specific published losses information is that standard accounting systems used in the food industry do not fully measure physical losses and associated costs. While it may be argued by some that the benefits accruing from this type of information do not merit the investment, it was apparent throughout the course of this study that the amounts of food losses and their causes are only vaguely and imprecisely known.

Even though comprehensive information on the causes of food losses was not generally available, fragmented data coupled with industry interviews produced many useful findings. Specific causes for losses vary from one product category to another and even among products within the same category. The causes of losses also vary at different stages of the food distribution system. However, there are four key causal factors at almost all stages of the distribution system. These nearly universal causal factors are: (1) improper temperature and moisture control; (2) improper or abusive handling; (3) poorly designed packaging; and (4) ineffective management.

Certainly for each product and product category there are other important factors contributing to losses. For instance, in fresh beef distribution, cutting losses are significant, while in the case of produce distribution, losses from trimming are large. It should be stressed that the factors leading to losses are interrelated. For example, in beef distribution, central fabrication into sub-primal cuts and vacuum packaging considerably decreases losses due to shrinkage in comparison with traditional carcass distribution system. It is the combination of more efficient handling systems and superior packaging which reduces the loss from shrink.

The fourth key cause of losses, ineffective management, deserves special attention. Management practices can either contribute to or reduce the possibility of losses from any of the other aforementioned factors. In fact, many instances of food losses can be greatly reduced by proper control of temperature levels, as well as handling and stocking procedures. Loss reduction is enhanced by proper training of employees and heightening their awareness of the problem. Many times this is not done because management itself is unaware of the overall magnitude of food losses and the potential for its reduction. However, from an economic perspective, not all losses require increased commitment of resources, but it is an observation of this investigation that a significant reduction in food losses could be obtained with a shift in management practices.

The philosophy of food system managers and society, is highly receptive to the concept of food loss reductions. Since the beginning of this nation, one of the primary philosophical precepts has been the ethic of "waste not--want not." Despite the heavy emphasis on consumption in the U.S. society, this ethic is with us today and may become even more strongly held as people recognize the importance of conservation as a result of sharply higher energy costs and food price inflation.

In the course of this research, the proposal to analyze food losses was generally well-received by those approached on the subject. In not one instance did food distribution executives indicate that some food losses were too small to bother with, even though certain losses may have been less than one-tenth of one percent of the volume of food handled. There was a prevailing sense that any economically feasible reduction would be a useful improvement, no matter how small the net gain. It seems apparent that most people find food waste, as a concept, to be objectionable whenever and wherever it

occurs--be it in the strawberry patch, during food processing and distribution, or at the dinner table.

However, attitudes and behavior are not always consistent. When discrepancies between attitudes and behavior are confronted, people frequently advocate that behavior be changed to conform to the preferred ethic. Yet, one must realize that the "waste not--want not" ethic ought not be blithely applied to each occurrence of food loss.

Certain economic conditions and issues are outlined below that must be considered if society is to benefit in an overall sense from food loss reduction efforts. In many cases, after consideration of the following economic principles, it may become more apparent that in some instances it is to society's benefit to accept as rationally tolerable a certain level of food losses rather than to completely eliminate them.

#### Economic Issues Relating to Food Losses

Consumers desire an adequate supply of wholesome food that is taste appealing, nutritious, and available at reasonably low prices. At the same time, food firms and individuals whose livelihoods are dependent on participation in the food system desire an equitable return for their efforts. Society expects a high level of efficiency in utilizing the nation's resources--of which food may be considered one. The attainment of these objectives is laudable and they are not necessarily mutually exclusive, but their accomplishment must be based on sound economic principles. In attaining any set of performance objectives, there may be instances where trade-offs occur. For instance, it is possible to provide consumers with a completely nutritious meal at a very low cost. However, such a meal may be extremely bland and unexciting. The following discussion highlights key economic principles as they may be applied

to questions of food losses and appropriate approaches for reducing them.

#### Applying Cost/Benefit Analysis

Benefits derived from loss reduction efforts must exceed costs. This is the most basic economic condition to be fulfilled if society is to gain from food loss reduction activities. The cost/benefit principle, as applied to food losses, can be expressed as follows: The value of the benefits which accrue from an effort to reduce losses must exceed the costs of achieving them. Thus, it is necessary to determine dollar values for the benefits and to establish dollar costs for the reduction effort even though this may be very difficult to accomplish. For example, issues such as "quality of life" and the "equity of outcomes," create serious problems when evaluating costs and benefits; however, factors such as these should be considered in the cost/benefit analysis. In the context of reducing food losses, if the dollar costs of reducing losses are greater than the value of all resulting benefits, then it will be in society's best interest to continue to tolerate the loss.

#### Minimizing the Cost of a Single Resource

It is seldom possible to maximize overall systems-wide efficiency by minimizing a single cost. Food, as it moves through the distribution system, can be viewed as both an output and an input resource. In this sense, food is an "intermediate good." Viewing food as a resource is beneficial when conceptualizing a benefit/cost analysis for the reduction of losses. This viewpoint brings into focus the notion that food is but one of many resources employed to accomplish the broad objectives of the food system. System-wide efficiency in the food system is concerned with the attainment of minimum total costs for meeting the food needs of our society. The costs of losses incurred while moving food through the sys-

tem is but one of these costs. Society must be concerned with overall system efficiency; the costs of all resources including labor, energy, equipment, and capital, as well as food losses. Efforts to minimize food costs without regard to the costs of other resources may, in fact, increase total costs.

#### Distinguishing Between Physical and Economic Losses

When analyzing food losses it is important to avoid equating physical food losses with the economic costs of those losses, since not all physical losses bear an economic cost. Moreover, not all economic costs of food losses are contained in the value of the physical item which has been lost. In some instances, it may be advisable to accept a certain level of physical losses in order to minimize food costs. The effort to retrieve the last ear of corn from a field, for example, may cost more than those few kernels are worth.

#### Consumer Acceptance of Loss Reduction

When products, services, and marketing philosophies are modified for the purpose of reducing losses, they must meet with consumer acceptance. A fundamental percept of our economic system is that the consumer is sovereign. A goal of the food distribution system is to fulfill the preferences of consumers as articulated by their action in the marketplace. To the extent that this goal is achieved in practice, consumer sovereignty determines the success of any loss-reducing innovation which is implemented. An alternative method of distributing fresh beef--frozen beef--is a case in point. According to some studies, frozen beef is an economically feasible method to reduce beef losses. However, consumer acceptance of frozen beef has yet to be established; and for this reason, frozen beef systems have been rejected by the industry as a viable means to reduce losses.



## Motivation to Reduce Food Losses

Reduction of food losses, per se, is not likely to be the sole motivating force behind broader efforts that do result in reductions of losses in the food system. In the past, changes in the food system to enhance efficiency have decreased food losses in some cases, and actually increased losses in others. Furthermore, those changes which have increased specific instances of food loss may have been economically defensible, on the basis of overall, system-wide efficiency improvement.

## Compliance With Food Wholesomeness and Safety Regulations

A compromise generally exists between minimizing losses and meeting other goals such as product safety and wholesomeness regulations, employee safety standards, and food company quality assurance policies. For example, regulations can result in losses of food for human consumption. However, such losses may be justified by reducing the risk of adverse effects on consumers' health and welfare. The sales expiration dates on milk, for instance, may lead to destruction of product. The issue is complicated by the reality that if such milk had been purchased and consumed immediately following the expiration date, it would in all likelihood have been safe for consumption as a flavorful and nutritious food product.

### Requisites for Loss Reduction

Economic considerations notwithstanding, there are a number of requisite occurrences and activities which will facilitate, and indeed, may be necessary for the achievement of substantial food loss reductions. A number of major requisites are listed below.

- Awareness and Measurement of Losses
- Communication of Economic Incentives

- Commitment to Change
- A Need for Research

### Loss Reduction: No Easy Answers

As is so often the case, when system-wide changes are made, not all sectors benefit commensurately with the investment made or inconvenience suffered. A generally acknowledged goal for the food system is equitable reward and treatment of the system's participants. Where changes involving increased costs for one sector of the food system are made to reduce losses and costs in another, mechanisms exogenous to the food system may be necessary and deemed appropriate to foster change. Various mechanisms may be considered, including direct subsidies, tax incentives, and so forth.

As food system participants implement changes to reduce losses and costs, organizations should prepare themselves to accept the possible paradoxical phenomena which may occur. Some changes of a radical nature leading to improved long-run food systems performance may initially cause increases in physical damage and losses. Such losses may persist until organizations are able to master newly implemented techniques and practices. Implementation of vacuum-packaged boxed beef, and mechanization of distribution centers provide only a few examples where considerable time has been required to overcome relatively high break-in period costs. Managers should realize that increased losses may be an inherent part of the process of change and progress. A long-term perspective by decision makers with respect to this issue is essential.

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### A Series of Reports on Food Losses

This paper is one of a series on "Losses In the U.S. Food Distribution System." Other papers in this series include:

- Fresh Beef Losses in the U.S. Food Distribution System
- Produce Losses in the U.S. Food Distribution System
- Dairy Product Losses in the U.S. Food Distribution System
- Dry Grocery Losses in the U.S. Food Distribution System
- Frozen Food Losses in the U.S. Food Distribution System
- Bakery Losses in the U.S. Food Distribution System

- Delicatessen Food Losses in the U.S. Food Distribution System

FOOTNOTES

<sup>1</sup>Seven companion reports provide more detailed findings from the study. These reports are identified at the conclusion of the paper.

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## LOSSES IN THE PRODUCE DISTRIBUTION SYSTEM: MAGNITUDES, CAUSES AND REMEDIES

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### Introduction

Following a decline since World War II, per capita consumption of fresh fruits and vegetables in recent years has shown signs of increasing. This apparent renewed consumer interest in produce, coupled with the highly perishable nature of these products, underscores the importance of the study of produce losses. The inherent perishability of produce, as well as the additional causal factors discussed in this paper, result in relatively large losses during the distribution processes.

This paper examines some of the aspects of produce losses in the distribution system. The National Science Foundation - Research Applied to National

Needs (NSF-RANN) commissioned the analysis of the magnitudes and locations of food losses occurring in the U.S. food distribution system.<sup>1</sup> The findings here are derived from that larger study.

"Produce losses" is a term subject to many interpretations. The purposes and nature of this study dictated the use of a number of different "produce losses" terms and concepts: (1) losses by weight, (2) economic value of physical losses, (3) total economic costs associated with losses, (4) shrinkage, and (5) losses resulting in reductions of either the quantity or quality of produce available for human consumption. Although different "produce loss" concepts were used, the study tended toward a single focus: an effort to develop esti-