CED-77-118
9-16-77

REPORT TO THE CONGRESS

BY THE COMPTROLLER GENERAL OF THE UNITED STATES

Food Waste: An Opportunity To Improve Resource Use

Department of Agriculture

About one-fifth of all food produced for human consumption is lost annually in the United States.

In the world context of rising population, uncertain weather, and concern with the availability of resources, every opportunity should be taken to improve food system management in this country.

More attention should be directed at the causes of food waste, new management technology for reducing loss, and improvement of consumer understanding.

CED-77-118

SEPTEMBER 16, 1977

COMPTROLLER GENERAL'S
REPORT TO THE CONGRESS

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TO IMPROVE RESOURCE USE
Department of Agriculture

D I G E S T

About 20 percent of all food produced in the United States is lost or wasted in 1 year--some 137 million tons valued at $31 billion. While all loss cannot reasonably be eliminated, reductions from the current level can lead to improved resource use.

Data on loss is available only in bits and pieces. In many instances GAO had to rely upon the best judgment of experts in the absence of hard data. Consequently, this assessment is based on a mix of statistics, estimates, and projections. (See ch. 3.)

To remedy this lack of comprehensive data on U.S. food loss, the Secretary of Agriculture should undertake a comprehensive study of both the magnitude and causes of loss.

SERIOUS IMPLICATIONS FOR FEDERAL EXPENDITURES

Large losses occurred at the consumption level--institutional and household. These losses have important implications for the efficiency of Federal food expenditures.

Both the Department of Agriculture and the Congress recognize that uneaten food thrown away (plate waste) is a problem in the National School Lunch Program. The degree of waste is within the same range in all reported group feeding situations. In fiscal year 1977, the Department has estimated obligations of $1.8 billion for feeding in an institutional setting. At this funding level, each 1 percent of plate waste would result in food loss of $18 million.

The Department of Agriculture's food stamp program contains an allowance for some food to be discarded without jeopardizing the nutritional quality of the diet. The allowance is determined fairly arbitrarily. With 1977

estimated obligations of $5 billion for the bonus value of food stamps (difference between value of food and price of stamps), each 1 percent of waste would result in food loss of $50 million. (See ch. 4.)

The Secretary of Agriculture should determine the extent and causes of food waste among food stamp recipients and in all Department-supported institutional feeding programs and take appropriate remedial action.

RESEARCH TO REDUCE LOSS LIMITED

Research to develop new equipment and procedures that would make reduction of loss feasible economically has received only limited financial support from the Department. Of 24,000 research resumes contained in the Current Research Information System (a listing of ongoing and recently terminated research projects) only 107 dealt, at least in part, with food loss. Within the Agricultural Research Service's fiscal year 1977 budget, 3.6 percent of the dollars and 4.9 percent of the time dealt with research related to loss. (See ch. 5.)

The Secretary of Agriculture should review the priority given research activities devoted to loss reduction as part of an overall assessment of research priorities GAO previously recommended.

HOUSEHOLD FOOD WASTE OF SERIOUS CONCERN

Households discarded the most edible food--worth $11.7 billion. Despite this, current information on the subject is rare. The University of Arizona at Tucson is, however, doing research on loss, including its causes. Results show that households with a strong knowledge of food safety have less waste. This study, which encompasses only Tucson, may not be representative of the Nation.

The Department has several publications on food safety which contain information for consumers on handling and storage practices that could reduce household food loss. It

does not have any publications whose primary focus is to reduce household loss. (See chs. 3 and 5.)

The Secretary of Agriculture should determine, on a national basis, the extent and causes of household waste and undertake broad educational campaigns if the causes are related to lack of knowledge of such subjects as food safety and efficient meal planning.

REDUCTION OF LOSS CAN CONSERVE RESOURCES

Reducing food loss is a way to

--improve the productivity and efficiency of the food system and

--increase food production at any given level of inputs of land, fertilizer, energy, and related factors.

At present, loss represents a large misallocation of resources. For 1974, about 66 million acres of land and 9 million tons of fertilizer were used to produce food ultimately lost. In energy, about 461 million equivalent barrels of oil were used to produce food ultimately lost. (See p. 38.)

LOSS AND HUNGER

Food lost represents a missed opportunity to feed the hungry. About 49 million people could have been fed in 1974 just from the lost food grains, meats, sugar, oilseeds, vegetables, and fruits. Nutritious food, that would otherwise be lost, could possibly be chaneled to the needy. The logistics of transporting this food sometimes has been an obstacle, but these efforts have potential. (See pp. 38 to 40.)

IMPACT OF TAX POLICY

Before 1970, the Federal income tax law encouraged the donation of food to exempt charitable organizations. This incentive was eliminated by the Tax Reform Act of 1969, but was partially reinstated for corporations by

the Tax Reform Act of 1976. However, the current law does not reintroduce the incentive found in the pre-1970 law for many farmers, because they are not incorporated. (See pp. 40 to 43.)

The Secretary of Agriculture should review opportunities for encouraging charitable donations of food that would otherwise be wasted, such as by extending the same tax benefits to unincorporated farmers that are already available to incorported ones or by an equally effective alternative program.

AGENCY COMMENTS

The Department is concerned that the estimates in the report will provide a false impression of loss.

It agrees that GAO's recommendation to undertake a comprehensive study is justifiable but believes that other inferences and recommendations should wait until the recommended study is completed. GAO believes that the Department does not give enough credit to the considerable attention the report gives to the availability and reliability of data and to the procedures used to arrive at estimates. Having identified food loss as an important area, exploring some of its ramifications is both appropriate and useful.

COMPTROLLER GENERAL OF THE UNITED STATES
WASHINGTON, D.C. 20548

B-114824

To the President of the Senate and the
Speaker of the House of Representatives

This report discusses the Department of Agriculture's past and current activities concerning food loss in the United States, as well as a broader assessment of loss.

We made the review to assist the Congress in developing a food policy by providing this assessment.

We made our review pursuant to the Budget and Accounting Act, 1921 (31 U.S.C. 53), and the Accounting and Auditing Act of 1950 (31 U.S.C. 67).

We are sending copies of this report to the Director, Office of Management and Budget, and to the Secretary of Agriculture.

Comptroller General
of the United States

ABBREVIATIONS

ARS	Agricultural Research Service
CRIS	Current Research Information Service
CSRS	Cooperative State Research Service
ERS	Economic Research Service
GAO	General Accounting Office
NRP	National Research Program
SRS	Statistical Research Service
USDA	U.S. Department of Agriculture

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harvest have important salvage value both as feed for gleaning by farm livestock and as fertilizer when plowed under or simply left in the field. Similarly, certain storage and processing losses can be used as animal feed and, to a lesser extent, industrial byproducts. In these instances, losses at one stage may be overstated while losses at other stages are understated. These uses represent a lower economic use and result in a reduction of human consumable food.

A 1974 United Nations report estimated that 462 million people are undernourished. Traditionally, the proposed solution to insufficient food is to grow more. Reducing loss offers the alternative to increase supplies through maximizing the use of current food production. Our recent report, "Hungry Nations Need to Reduce Food Losses Caused by Storage, Spillage and Spoilage," (ID-76-65, Nov. 1, 1976) concludes that a tremendous opportunity exists for increasing the food supply in the developing countries by reducing post-harvest losses. Another study, "Wastage in the United Kingdom Food System," concludes, among other things, that considerable food loss exists in the United Kingdom and that in the world context of rising food prices and rising demand for food, considerations of wastage will likely become increasingly important.

Our reports on the school lunch program, in part, address plate waste, which is an important element of food loss. The "Impact of Federal Commodity Donations on the School Lunch Program," (CED-77-32, Jan. 31, 1977) devoted considerable attention to the plate waste problem. "The National School Lunch Program--Is It Working?" PAD-77-6, issued July 26, 1977, and the "Summary of a Report: The National School Lunch Program--Is It Working?" PAD-77-7, issued July 26, 1977, which is a summary of the previous report, also touch upon the waste problem.

SCOPE OF STUDY

The focus of this study is food loss on a national level from field to kitchen. An intensive literature search was made to identify information on loss. (See selected bibliography, app. I.) We held discussions with U.S. Department of Agriculture (USDA) officials in Washington, D.C., and California as well as with industry and trade association officials primarily in those geographic areas. At our request several trade associations also polled a portion of their membership about loss. We also attended the National Food Loss Conference in September 1976.

CHAPTER 1

INTRODUCTION

The American perspective of the food system has traditionally been one of plenty. This has changed as the perspective has shifted to a global view with its population growth, uncertain agricultural system, and hunger ramifications. With the United States exporting large quantities of agricultural products, concern arises over the competition for future food supplies. Recent policy has been to encourage full agricultural production, planting from fence post to fence post. Should the United States or the world encounter a bad crop year, however, it may be necessary to choose between allocating abundant supplies for domestic use, with a moderating effect on food prices, or continuing to meet export market demand with attendant upward pressure on food prices. The lack of substantial worldwide food reserves presents a more uncertain future than the world's experience since World War II. The United States can no longer be lulled by past agricultural surpluses and must consider a future that may contain a world shortage of food.

In an environment of plenty, the United States has not historically been concerned with food losses. Although some attention has been focused on the subject in the agricultural research community, in many instances, plentiful food and low prices did not justify the economic expenditure necessary to reduce loss. In an era of potential scarcity, however, it may be necessary to reexamine the present position on losses.

We examined those aspects of the U.S. food system related to loss from field to kitchen with the exception of seafood and imports. We assessed the extent of current knowledge, estimated the level of loss in 1974, the latest year for which broad-based data on loss was available, and explored some of the ramifications of loss.

Traditionally, loss has been discussed under two major headings--on-farm and off-farm loss. On-farm loss includes any losses from production to farm-gate, ranging from reduced yields due to insects, weeds, and other factors to loss of actual product during harvest. Off-farm loss includes all loss occurring after food leaves the farm. We considered loss during harvest plus off-farm loss, but excluded that portion of on-farm loss related to yield reduction. The rationale for this is that the loss considered includes only food actually produced and potentially available for consumption, either directly, or indirectly as animal feed. It should be noted that commodities left in the field after

CHAPTER 2

MEASURING FOOD LOSSES

For the purpose of this report, loss is defined as the edible portion of any agricultural product no longer usable. A variety of measurements may be used for measuring loss, such as:

--Total weight loss: The change in the weight of the product as it progresses through each phase of the system.

--Nutrient loss: The decline in nutrients of any food product.

--Dollar loss: The dollar value of food products lost for human consumption.

Generally, two scales--total weight and total dollar loss--were selected because of

--a concern for the physical total of human food lost (total weight loss),

--a need for an economic measure of the impact of loss (total dollar loss), and

--the capability to convert existing data into those bases more easily than some of the alternatives.

Nutrient loss was not selected because of the lack of data and differing degrees of loss under different conditions.

To the extent possible we endeavored to limit loss to the edible portion of food. Where it has not been possible to limit measurement to edible loss, attempts were made to factor out the inedible portion--i.e., debris, skins, pits, etc.--from the total. However, changes in agricultural practice can result in a change in what is considered edible. For example, wheat is grown for its grain value; however, the straw, a product of negligible value at present, is being considered as a huge potential source of animal feed. As a result, the total output of "wheat" could be doubled on a weight basis if wheat straw becomes a viable animal food source because for each ton of wheat grain produced, a ton of straw is also created. Presently wheat straw is not considered a loss nor a component of the food system.

MANY WAYS TO VIEW LOSS

Food loss has many connotations; for some it brings forth images of milk dumped by dairy farmers, baby chicks destroyed by poultry producers, and calves slaughtered by ranchers. But there are many ways to view food loss. There is the absolute loss of any edible food product. Some food, such as the coarse grains used as feed in America, is considered culturally inedible, and hence is lost for human consumption. This point recognizes that certain foods will not be eaten in a given society because they are unacceptable due to custom, religious restriction, or other reasons unrelated to the edibility of the food.

Nutrient loss occurs during the life of a food product and although the food is consumed there may be less nutritive value. Dollar loss reflects the monetary value of a lost food product. It is important to define the perspective from which one views loss and to be aware of the varying ways by which it can be measured.

WHY WORRY ABOUT LOSS?

Within the United States there are enough supplies of most foods. Nevertheless, important reasons exist for examining the efficiency of the food system with respect to food loss. Among these are:

--Loss of food is accompanied by unproductive use of resources used to produce food, including energy, land, fertilizer, labor, capital, and other materials. Furthermore, the farther downstream the loss occurs the greater the resources applied to the food and their ultimate unproductive use when food is lost.

--Reduction of loss would result in greater food availability at any level of input.

--Certain foods lose their nutritive value during storage, handling, and processing, reducing their contribution to the consumers' diet often without the consumers' knowledge.

--Loss can add to the cost of providing food to the consumer and, as such, raise its price.

absorb (i.e., not be able to sell) their peach production if they did not have firm contracts with processors. Although this did not happen because of a strike and poor weather, it points out how important the absence of certain harvest loss data can be in estimating loss.

Lettuce illustrates the problems associated with vegetable production data. When price drops (oversupply) below harvest cost, the remainder of the crop is not harvested and consequently, the fields are plowed under. When the price is high, everything is picked. Industry officials estimate the periods of oversupply are matched by the periods of undersupply: however, no information is recorded on the amounts plowed under, and hence lost. Actual losses may be reduced since some producers will allow senior citizens' groups to pick over fields that are not marketed. One group is picking up about 4 tons of vegetables a week in Monterey County, California. The lack of availability of data on crops actually available for harvest results in understating loss. The question unanswered is to what extent is loss understated.

Storage

Storage losses are among the best documented of all losses in the food system. Considerable research by USDA, the States, and private organizations has identified loss rates for many commodities. Reliable data on the storage losses of fruits, vegetables, and minor field crops are, however, largely missing. As a result, estimates have not been developed on the total losses of these commodities. A select few, such as lettuce, oranges, and potatoes have good loss rate data developed as a byproduct of the Agricultural Research Service (ARS) research into storage improvements.

Transportation

Railroads, among the first to become involved in the long haul transportation of perishable commodities, accumulate extensive data on claims paid for losses ($88 million in 1974) and considerable information on the causes of these losses. Data is not available on undetected losses or those where claims were denied by the railroads. No loss data is available for the large quantities of food moved by truck and other forms of transportation. Loss rate data, developed through USDA and private studies, had to be used in developing estimates.

Processing

Processing is probably one of the more loss conscious parts of the entire food system. The production efficiency

DATA AVAILABILITY GENERALLY MIXED

USDA publishes considerable information on crop production, economic value, and many other important aspects of the agricultural component of the food system. Detailed information on loss, however, is sparse. The most comprehensive studies on this subject were two reports, entitled "Losses in Agriculture," published by the Department of Agriculture--one in 1954 and the other in 1965. They contained composite data for the years 1942-51 and 1951-60 in the 1954 and 1965 publications, respectively. Both reports concentrated on preharvest (i.e., growing) losses, with more limited data on post-harvest losses. Both also noted that, in many instances, the data was the best judgments of USDA experts due to the lack of specific measurements.

Limited data also exists on losses for a variety of specified commodities and on areas of loss which have been the subject of specific research. The following sections discuss data availability for each component of the food system and identify whether the data is considered reliable, estimated, or nonexistent.

Harvest

USDA publishes information on planting intentions, acres planted, and crops harvested which is considered reliable. However, almost no data is collected on the crop actually available for harvest. The data had to be estimated on the basis of actual harvest and known loss rates during harvest. The loss rates used in this report were obtained from sources based on

--broad samples,

--narrow samples or excerpts from scientific papers, or

--estimates of knowledgeable individuals.

Available for harvest data was not developed for vegetables, fruit, and nut crops because the impact of supply-demand marketing leaves fields unharvested or less completely harvested than technologically feasible. Thus, table 1 on page 11 reflects actual harvest figures as the amount available for harvest, with loss indicated to be an unknown.

The following examples help illustrate the missing figures. The California cling peach crop for 1976 was forecast at 700,000 tons, 100,000 tons in excess of anticipated demand. Consequently, some farmers could be expected to

Recently, however, a new approach has emerged entailing less consumer bias. In 1971 at the University of Arizona at Tucson, an anthropology study 1/ group developed a technique of analyzing garbage and estimating losses. These are the principal values of the technique.

--It does not rely on self-recording of any data by the consumer.

--It has been structured to recognize family size, ethnic background, and income level.

--It can be duplicated each year to examine the impact of market changes on consumers.

Qualifications of the data generated largely relate to

--the breadth of food amenable to study (milk and other fluids lost cannot be measured in the garbage) and

--geographic limitations of the study so that its representativeness is unknown.

This group plans to continue analyzing consumption patterns, but no plans exist for broadening its geographic base. Therefore, representativeness on a national basis is not assessable.

1/Rathje, Hughes, Harrison, Jernigan, "Food Loss at the Household Level," July 30, 1976.

of most processors is monitored and, in this way, loss data is generated on a plant-by-plant basis for a number of commodities. The data is generally reliable, but problems still exist due to

--the inability to aggregate this data due to the array of multiple-product ingredients,

--many plants which inhibit collection of data due to its fragmented nature, and

--the use of different definitions of loss.

USDA has published considerable data concerning animal system losses which are contained in the annual summaries of the results of its meat inspection activities.

Wholesale/retail

Data on product disappearance at the wholesale and retail level is based on inventory shrinkage. This can be defined as the difference between (1) the retail value of purchased inventory and (2) the sum of retail sales and the retail value of inventory on hand. Shrinkage is attributable to many factors, including breakage and spoilage, which are elements of food loss. Data on shrinkage is limited. Within shrinkage it is normally not possible to isolate the component parts.

Industry officials have not developed data to identify specific loss causes although they are concerned about the amounts. Our estimates of that part of shrinkage attributable to breakage and spoilage are based on the views of industry officials and some rather dated USDA studies, which combined represent the best data we could identify.

Restaurants, institutions, and households

Data on institutional food loss is fragmentary at best. Data on household loss has, until recently, relied upon consumers who observed and recorded discards. USDA researchers conducted studies of this aspect of the system in the 1950s and 1960s, and problems arose with the methodology because results relied, in part, on the consumers' cooperation over lengthy periods of the studies. Qualifications were noted regarding bias due to

--the impact on self-esteem of consumers who found they were wasting food,

--the time required to weigh and record data, and

--the classification of material as edible or inedible.

CHAPTER 3

FOOD LOSS

We assembled data on the level of food loss for 1974 by piecing together information for various commodities at various stages of the food system. This was the most recent year for which considerable data was available on which to base estimates. It is important to emphasize that all data relating to loss in this report is based on the best information, including published studies, loss rates, and expert judgments, we could identify. A selected bibliography on food loss, and a methodology describing the estimating process are included as appendixes I and II, respectively. Although the data has defects, it provides a reasonable overview of loss.

In 1974 we estimate that a total of about 691 million tons of crops were available for harvest in the United States. Of this total, 137 million tons of crops, or 20 percent of the total weight of crops produced, were ultimately lost. Almost one-half of the total harvested was processed; about 40 percent was used to feed animals and create animal products. The crops harvested had accumulated a value at point of sale to the consumer of $149.3 billion, while loss, valued at the point lost in the food system, aggregated to $31 billion.

Table 1, on page 11, aggregates data on a commodity group basis at each stage in the food system. The estimated quantity of food entering each stage and the estimated quantity lost are recorded. Exports are removed from the table at the point at which the commodity leaves the United States. Since exports are not listed, quantities across the table do not add at each point. No data is presented in instances where information did not exist and could not be estimated. That corresponding area is indicated as unknown, and the quantity of food entering the next stage is not reduced from the level at the previous stage. At most stages this procedure was workable. However, at the consumption stages--institutional and household--only overall loss rates were available, with no commodity breakdown, and it was necessary to apply these rates to the total quantity of food entering these stages. This yielded an estimate of total loss, but no breakdown by commodity. At wholesale/retail only data on fresh fruits and vegetables is available, which is the indicated total. Animal products, i.e., meat, milk, and eggs, are an intermediate part of the food system because crops are used to generate them. They appear as a food product at the processing stage, where they are first measured in the table.

FOOD WASTE: AN OPPORTUNITY TO IMPROVE RESOURCE USE DEPARTMENT OF AGRICULTURE

CED-77-118
~~B-114824~~
9-16-77

We reviewed the Department of Agriculture's past and current activities concerning food loss in the United States and made a broad assessment of loss and its implications.

We reported that:

1. About 20 percent of all food produced in the United States is lost and wasted in 1 year - some 137 million tons valued at $31 billion.
2. Data on loss is available only in bits and pieces and our assessment had to be based on a mix of statistics, estimates, and projections.
3. The large losses in institutions and households have important implications for the efficiency of Federal food expenditures.
4. Research to reduce loss is limited.
5. Reduction of loss can conserve resources of land, fertilizer, energy and related factors.
6. Nutritious food, that would otherwise be lost, could possibly be channeled to the needy.
7. Household food waste is a serious concern of which little is known.

We recommended that the Secretary of Agriculture should:

--undertake a comprehensive study of both the magnitude and causes of loss to rectify the current lack of knowledge and to focus

research attention in the most promising areas.

--determine the extent and causes of food waste (1) among food stamp recipients and (2) in all Department supported institutional feeding programs and take remedial action as appropriate.

--review the priority given research activities devoted to loss reduction.

--determine, or a national basis, the extent and causes of household waste and undertake broad educational efforts to the extent that causes are related to lack of knowledge of such subjects as food safety and efficient meal planning.

--review opportunities for encouraging charitable donations of food that would otherwise be wasted.

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AGRICULTURE PROGRAMS

Education

Need to undertake broad consumer education efforts to the extent food waste is related to lack of knowledge.

Food Stamp, Child Nutrition and Other Feeding Programs

Need to determine the extent and causes of food waste and take remedial action as appropriate.

Incentives

Need to review opportunities for encouraging charitable donations of food that would otherwise be lost.

AGRICULTURE PROGRAMS

Research

AGRICULTURE PROGRAMS

Need to undertake a comprehensive study of food loss, review the priority given food loss research, and determine extent and causes of household food losses.

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TABLE 1

ESTIMATED FOOD ENTERING EACH COMPONENT OF THE FOOD SYSTEM AND ESTIMATED LOSS IN THAT COMPONENT ON A TOTAL WEIGHT BASIS CROP YEAR 1974 (notes a and b)

(000 TONS)

COMPONENT	ESTIMATED AVAILABLE FOR HARVEST	LOSS	HARVESTED	UNITS STORED	LOSS	UNITS TRANSPORTED	LOSS	ANIMAL FEED DIVERSION	UNITS PROCESSED	LOSS	WHOLESALE/ RETAIL	LOSS	INSTITUTIONS	LOSS	HOUSEHOLDS	LOSS
													INSTITUTIONAL[c] LOSS RATE 15%		HOUSEHOLD[d] LOSS RATE 10.8%	
Feed Grain	320,700	19,100	283,600	283,600	19,800	[e]263,800	800	211,700	19,200	Unknown	18,700	Unknown	Unknown		Unknown	
Food Grain	63,200	3,200	60,000	60,000	2,100	57,900	300	2,200	30,400	[f]400	26,700	Unknown	Unknown		Unknown	
Sugar	49,700	1,600	48,100	DIRECT TO PROCESSING		48,100	Unknown	Unknown	48,100	3,500	44,200	Unknown	Unknown		Unknown	
Oilseeds	48,200	4,400	43,800	43,800	300	43,500	500	600	29,600	Unknown	24,000	Unknown	Unknown		Unknown	
Vegetables	41,200	Unknown	41,200	41,200	Unknown	41,200	800	Unknown	23,700	1,100	38,300	[g]700	Unknown		Unknown	
Fruits, Nuts and Coffee	25,200	Unknown	25,200	25,200	[h]100	25,100	600	Unknown	[h]17,100	1,000	21,000	[g]200	Unknown		Unknown	
Hay and Minor Crops	160,800	31,700	129,100	129,100	12,700	116,400	Unknown	114,700	1,700	Unknown	1,400	Unknown	Unknown		Unknown	
Meat, Milk, Eggs	-	-	-	-	-	-	-	-	90,600	100	90,300	Unknown	Unknown		Unknown	
TOTAL	691,100	60,000	631,100	583,000	35,100	596,000	3,000	329,200	260,500	6,000	264,700	900	74,100	11,115	190,600	20,600

[a] Column totals may not add due to rounding (all numbers rounded to the nearest hundred thousand tons

[b] Exports are removed from the table at the point at which the commodity leaves the country

[c] Loss rates for institutions are from a survey of the National School Lunch Program

[d] 1974 has the lowest loss rate, 1973 had a 12 percent rate. The loss rates are from the Tucson garbage study.

[e] Units transported include corn and sorghum silage stored on farms.

[f] Data missing for several important components

[g] Loss applies to fresh only

[h] Nuts excluded, no data.

fruits are believed gleaned and estimates on vegetables range from 10 to 20 percent except for potatoes, of which 50 percent is believed to be gleaned. Crops left in the field and not gleaned also fertilize the field. However, gleaning and and fertilizing value represent a lower economic use than that for which the commodity was grown.

Reasons for loss vary

Many losses of agricultural commodities can be attributed to mechanization--others to improper (1) management, (2) spacing of rows, and (3) adjustment of equipment.

Inferior or immature products were not gathered when crops were hand harvested, but harvesting costs often amounted to one-half or more of the total payment the producer received. Mechanical harvesting, though, is indiscriminate, and immature as well as ripe products are harvested with the immature products ultimately discarded. But the end result is that machinery has enabled the farmer to harvest more acres with fewer workers at less cost. The added crop loss is an attendant penalty of increased overall economic efficiency.

Loss rates vary considerably depending on the crop. Some crops, such as wheat, are more susceptible to efficient harvesting and have a lower loss rate. Other crops, such as soybeans and hay, are more difficult to harvest and thus suffer greater losses.

Soybeans, the United States number one cash crop in 1974, suffer from about 10 percent harvest loss. While not an especially new crop, the harvesting equipment used for soybeans was designed for wheat and barley. The principal reason for the difference in harvest efficiency between wheat, with a 5 percent loss rate, and soybeans, is the nature of the plant. Wheat resists lodging, a tendency of the plant to topple over, and wheat grains are in a compact head. Soybeans tend to distribute around the plant and drop to the soil as they ripen.

Hay, alfalfa in particular, has its principal food value in the leaves. General practice is to cut, rake, turn, and bale the hay. Depending on the level of moisture in the hay when it is baled, more leaves will adhere to the stem. Statistics published in 1972 indicate that as much as a 25-percent weight loss, due to leaves broken off, occurs with the standard method of harvesting hay. 1/

1/"Alfalfa Science and Technology," American Society of Agronomy, Madison, Wisc., 1972.

Table 2 shows the dollar value of loss obtained, in most instances, by applying the price for each commodity at the stage it was lost to our estimates of quantity loss and aggregating to a total value. At wholesale/retail levels a shrinkage factor was used in the absence of substantial quantity loss data. At the institutional and household levels a percentage loss figure was applied to the total dollar value of food entering that stage.

Table 2

Estimated Economic Loss of Food

	(000 omitted)
Harvest	$ 5,000,000
Storage	2,200,000
Transportation	400,000
Processing	600,000
Wholesale/retail	6,200,000
Consumer	16,100,000
Total	$30,500,000

HOW LOSSES OCCUR

Each stage in the food system has unique problems that vary by crop. The following sections describe some examples of the more significant losses at each stage. Loss factors are summarized on page 24.

HARVEST LOSSES

Amounts large but some recovered through gleaning

We estimate that the loss during harvesting for crop year 1974 was 60 million tons of food valued at $5 billion. Some harvest loss was gleaned by animals, although little information is available on the proportion of harvest loss gleaned and no hard data is available on the quantity. Academic researchers told us that as much as one-third of the corn lost in harvest was gleaned. Little wheat and barley lost was gleaned because the animals were not in the major wheat and barley growing areas. A portion of the straw, which was generally not considered as food, was consumed by animals. We were told that no estimate exists on gleaning of soybeans but it is believed that animals primarily eat the soybean plant, leaves, and stems with cattle not grazing close enough to the ground to pick up the soybeans. No

We were unable to locate any data on what proportion of storage loss was usable as animal feed. However, certain causes of storage loss render commodities unsuitable for animal as well as human consumption.

Many products harvested are stored, and a loss occurs in most stored products. Storage losses are caused by insects, mold, deterioration, and shrinkage (i.e., the loss in weight or volume of an agricultural product). Some products lose their nutritional value when stored and the result is a downgrade of the product. For example, prunes stored for more than 12 to 15 months lose their nutritional value and are used to manufacture concentrates, such as juice and syrups. Eggs experience a weight loss during storage which also results in a downgrade of the product. For example, grade AA eggs cannot be stored for more than 5 weeks before they drop to the next lower grade and the process continues as long as the eggs are in storage (for up to 6 months).

On the other hand, some products, such as rice and soybeans, experience little or no loss during storage. Rice will store almost indefinitely after it is dried and in the unmilled or unhulled stage. Rice growers use this method and the result is little or no loss during storage. Soybeans experience a small loss during storage because most soybeans are moved off farms into commercial-type storage and losses in commercial-type storage are less than in farm-storage facilities.

TRANSPORTATION LOSSES RELATIVELY SMALL

We estimate that transportation loss in crop year 1974 totaled 3 million tons of food, valued at $400 million. We were unable to locate any information on the use of food lost in transportation for animal feed or other purposes.

Losses, when they do occur, are often attributed to spoilage, contamination, and rough handling. A major factor in the spoilage of fresh produce appears to be time in transit. One official indicated that his firm had experimented with air freighting lettuce across the country. Upon receipt of the lettuce crates, they would burst upon opening due to the respiration process of the lettuce. In contrast, lettuce shipped by rail would arrive limp and no similar bursting accompanied opening crates.

PROCESSING LOSSES REFLECT COST CONSCIOUSNESS

We estimate that processing loss in crop year 1974 equaled 6 million tons of food, valued at $600 million.

Activity to cure both problems are underway. One solution for hay is field chopping and dehydration, which reduces the leaf loss problem. However, the energy cost for dehydration is prohibitive in most locations because of high cost and limited supplies of natural gas. The long-term solution to soybean harvest appears to be plant breeding. Improvement in harvesters and harvesting techniques may provide interim improvements, depending upon the success of industry's efforts in this area. Similar problems exist in harvesting rice, many vegetables, and tree crops.

ANIMAL FEED DIVERSION

About 40 percent of raw agricultural production is used in the creation of meat, milk, and eggs. Weight loss occurs at this stage because animals are limited in their efficiency of converting hay, grain, and other feeds into meat, milk, and eggs. At present it takes about 9 pounds of feed to produce 1 pound of live beef, 2 pounds of feed to produce 1 pound of chicken, and 1 pound of feed to produce 3.8 pounds of milk. Feed, in this instance, includes not only concentrated animal feed but also grass, hay, and any other commodities consumed by animals. In addition, it is estimated that an average 2.28 pounds of live, choice steer are required to bring 1 pound of choice beef to retail foodstores. This translates to 20.5 pounds of feed to produce 1 pound of beef at retail.

Animal feed diversion must be considered in tracing total food product through the system, given the proportion of food output used as feed in this country. Whether conversion is a loss must be considered from the standpoint of protein value, land suitability for other crops, and cultural edibility. One study 1/ suggests that conversion is not a loss since 75 percent of the inputs are not normally used as human food. Thus, it could be argued that this is a conversion gain. Others would argue from the standpoint of the farm potential for human food, and the potential world benefits from more grain and less meat production.

STORAGE LOSSES RELATIVELY LARGE

We estimate that the loss in storage for crop year 1974 was 35 million tons of food, valued at $2.2 billion.

1/Moore, Putnam, and Bayley, "Ruminant Livestock, Their Role in the World Protein Deficit," Agricultural Science Review, 2nd Quarter, 1967.

WHOLESALE AND RETAIL LOSSES SUBSTANTIAL

We estimate that wholesale and retail loss for 1974 totaled $6.2 billion. A 4-percent loss rate, comprised of 2 percent at wholesale and 2 percent at retail, was used for all commodities based on our analysis of existing data and the judgment of industry officials. We expect this is lower than actual experience. However, enough data was not available to use higher estimates. It was not possible to estimate quantity loss except for fresh fruits and vegetables due to the inability to develop loss rates for the broad selection of items carried by the industry.

Industry officials told us that, in the past, 10 to 15 percent of wholesale/retail losses on a quantity basis were used as animal feed but that this is declining over the long term.

Loss data at wholesale and retail is among the least complete of all segments of the food system. Sufficient data, however, does exist to evaluate the significance of the losses on a dollar basis. Some of the more important individual loss factors at wholesale and retail are

--deterioration of fresh fruits and vegetables,

--damage of commodities in bags and bales, and

--broken containers.

CONSUMPTION LOSSES LARGEST DOLLAR LOSSES

We estimate that total consumption loss, both household and institutional, equaled 32 million tons of food valued at $16.1 billion. This reflects the greater impact of loss at the end of the food stream, after all value has been added. Professionals we contacted seem to agree that the most significant losses on a dollar basis are at the consumption level, both institutional and household.

Institutional loss has high loss rate

We estimate that institutional loss in 1974 totaled 11 million tons of food, valued at $4.4 billion. Industry officials told us that, as with wholesale/retail, 10 to 15 percent of institutional losses on a quantity basis were used as animal feed but that this proportion is declining over the long term.

Based on several recent studies, the institutional loss rate is higher than the household loss rate. The amount of

Industry officials told us that about 80 percent of food and feed grain losses are recycled as animal feed or industrial byproduct. All sugar-processing losses are used as animal feed, 10 to 20 percent of vegetable loss, and from zero to 35 percent of fruit loss. No information was available on recycling oilseed loss. Although these losses had some economic value, they can be viewed as having a lesser economic value in this secondary use as opposed to their primary use as food.

Nearly all agricultural products are processed into a food form. Some, such as wheat, change form drastically from grain to bread; others, such as peaches, are simply pitted, sliced, and canned. Depending upon the nature of the processing, the potential for loss from a human food standpoint varies considerably. Overall the data found indicates processing to be one of the more loss conscious segments of the food system.

Several illustrations show the nature of processing and the types of problems that result in losses. Tomatoes are processed whole for canning as stewed tomatoes and pureed into paste or juice as well as other forms. In many cases one step is to remove only the skin and none of the pulp. It is seldom achieved, and ARS studies show the loss can be held to about 16 percent, including the peel, through dry caustic peeling. 1/

Sugar processing demonstrates planned processing loss. Sugar beets are tested for total sugar content, and contract prices are paid on that basis. Processors have a choice between one- and two-step processing. One-step refining results in about 72 percent of the potential sugar yield being achieved, the remainder being a molasses slurry used in animal feeds. Two-step processing yields about 90 percent of the available sugar. The choice is economic; some companies use one step, some two step, based on their judgment of the maximum profit point.

Other processing operations have their unique features; all, however, involve some loss.

1/Processing losses have been reduced in many cases through antipollution activities. Tomato waste reduction is a good example.

--The biggest food wasters are middle-income families, not the very rich or very poor. The middle-income neighborhoods waste almost 25 percent.

--Over half the food thrown out over a 3-year period was not table scraps; it was straight waste--a half-a-loaf of bread, untouched fruits, half a bag of vegetables and, in some cases, unopened packages of food.

--Tucson's households waste an average of $80 to $100 annually in edible food. In 1974 it was estimated that Tucson's families wasted $570,000 worth of beef, $1,326,000 worth of vegetables, and $750,000 worth of pastries.

--Each week Tucson's families throw away enough edible food to provide a week's worth of meat, poultry, or fish for more than 3,000 people.

The study also indicated that households with a strong knowledge of food safety had less waste.

OTHER FACTORS RESULTING IN LOSSES

The food system is both intricate and sophisticated. It requires that inputs be available at the right time in the right place. To the extent that this does not occur, the system risks additional loss because of the perishable nature of many crops and the importance of planting at the proper time. This makes the system particularly vulnerable to deprivation of critical inputs. Energy is one example, and during the energy crisis agriculture was given the highest priority in receiving its energy needs.

The food system is also particularly sensitive to strikes and related labor discontent. An overall assessment of the loss of food due to strikes is not available because the number of strikes varies by year and is not believed to be large, and strikes in nonspecifically agricultural sectors, such as processing plants, have a significant but difficult to measure effect on the food system. A recent strike situation in California provides an illustration of how potentially vulnerable the food system is today.

In July 1976 workers in peach, apricot, and tomato processing establishments struck for higher wages and improved working conditions. While the actual outcome in terms of lost food is never certain, State and producer estimates were similar enough to indicate the impact on the grower and food system was significant. The loss was estimated to total more than 225,000 tons and had a retail value of about $174 to $208 million.

data concerning food use pattern and loss is, however, fragmentary at best. Current figures for institutional losses are in the 15- to 20-percent range, which includes disposal of entire products as well as plate scrappings.

One study of plate waste, in a USDA analysis of the National School Lunch Program, showed the following results:

Food category	Percent thrown out
Meat	14
Fruits and vegetables	35
Bread and butter	15
Milk	13
Overall average by weight	19

On a weighted basis, the most likely overall estimate for the program was put at 15 percent. Similar experience has been reported for the military.

The school lunch study referred to U.S. Army plate waste averages which are in the range of 14.5 to 15.3 percent of the entire meal.

Also, an additional economic cost associated with losses exists at the consumption level in that the user must pay to dispose of the loss, which is now waste, i.e., unusable. A burden is also placed on the municipal waste system. This is true both at the institutional and household level.

In an effort to reduce plate waste in restaurants, USDA has had some success in convincing restaurant operators to offer different portion sizes. This offers diners who normally cannot consume a complete conventional serving the option of ordering, at a lower price, a smaller serving size. There is assumed to be an attendant reduction in plate waste.

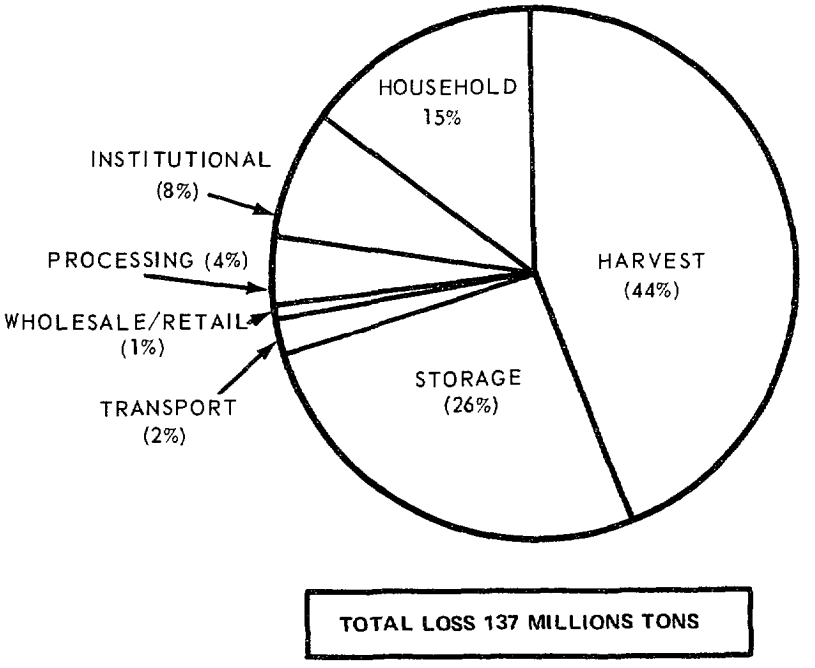
Household loss single largest dollar loss

We estimate that household losses totaled 21 million tons of food valued at $11.7 billion. No household losses are recovered for other use.

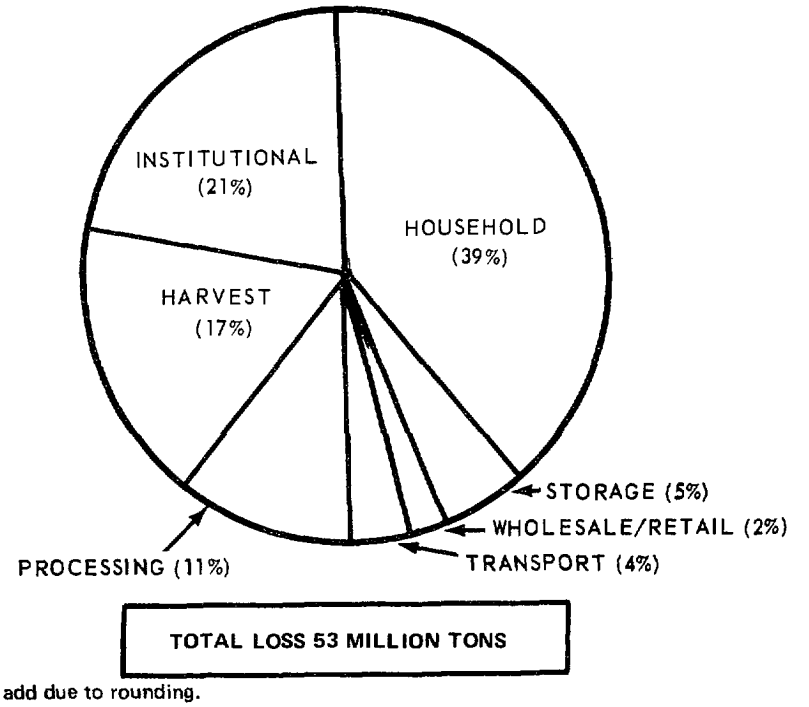
Several studies, some of them quite old, have been made regarding household losses. A more recent study, made in the Tucson, Arizona, area, categorized overall losses as 10.8 and 12.0 percent of 1974 and 1973 household purchases, respectively, which are consistent with the findings of the earlier studies. Some additional findings the study noted are:

FIGURE I

ESTIMATED COMPOSITION OF TOTAL FOOD LOSS BY SEGMENT OF THE FOOD SYSTEM CROP YEAR 1974



ESTIMATED COMPOSITION OF LOSS OF FOOD PRODUCED PRIMARILY FOR HUMAN CONSUMPTION BY SEGMENT OF THE FOOD SYSTEM CROP YEAR 1974



NOTE: Totals may not add due to rounding.

CAUSES OF LOSS IN REVIEW

Figure I on page 22 examines the distribution of loss on a weight basis by segment of the food system. Loss at harvest is the most significant area, accounting for more than two-fifths of the total. Storage loss is next in importance. In terms of food produced primarily for human consumption, consumer loss represented the lion's share, three-fifths, followed by harvest and processing loss.

Figure II on page 23 examines loss on a value basis. The impact of value added to food as it moves through the stream becomes apparent in viewing the composition of dollar loss. Consumer loss accounts for more than half of the total, followed by wholesale/retail loss.

Table 3 on page 24 has been prepared from many varied sources of information to summarize causes of loss by segment of the food system. It should be viewed in conjunction with the material presented on the magnitude of loss to maintain a proper perspective. There are a myriad of factors contributing to food loss. Within any given stage of the food system, however, there are also many common elements.

TABLE 3

LOSS FACTORS

CROPS

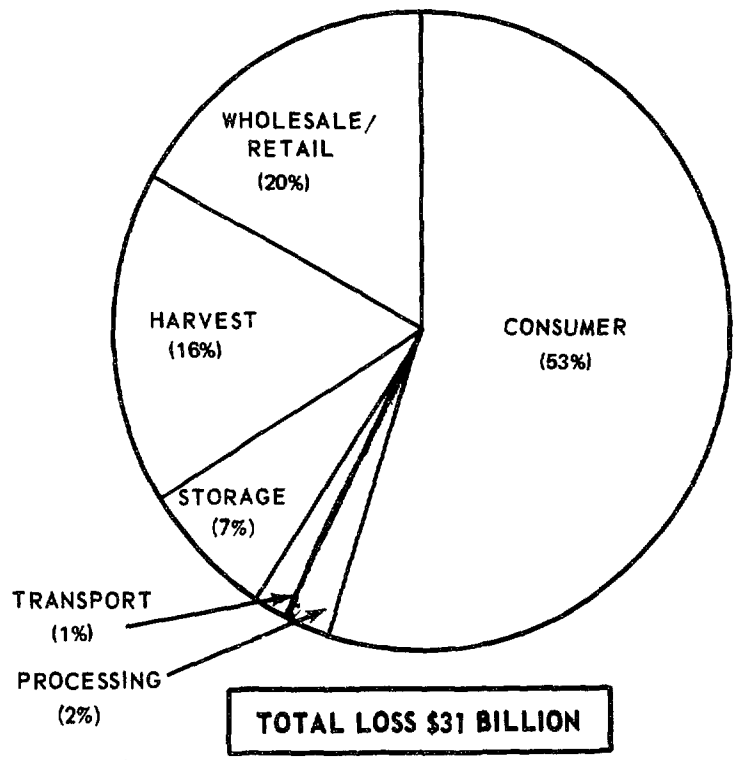
HARVEST	STORAGE	TRANSPORTATION	PROCESSING	WHOLESALE/RETAIL	INSTITUTION/ CONSUMER
Machine design	Insects	Insects	Machine design	Poor management	Insects
Mechanical injury	Molds	Molds	Washing	Improper handling	Molds
Lodging	Rot	Rot	Grinding	Breakage	Rodents
Mechanical sizing	Rodents	Ventilation	Culling	Temperature	Overpreparation
Demand/price	Ventilation	Transpiration	Technology	Moisture	Plate waste
Relative maturity	Temperature	Spoilage	Peeling	Bruising	Spillage
Machine shattering	Moisture	Temperature	Trimming	Time	Overpurchase
	Transpiration	Light	Pitting		Temperature
			Coring		Time

LIVESTOCK

Field deaths		Animal condition	Condemned	Spoilage	Spoilage
Disease		Crowding	Trim-bruise disease	Demand/ price	Plate waste
Mismanagement		Slippery floors	Bones and other material		Overpreparation
		Mixed species	Temperature		
		Ventilation	Contamination		

FIGURE II

ESTIMATED COMPOSITION OF LOSS ON A VALUE BASIS BY SEGMENT OF THE FOOD SYSTEM CROP YEAR 1974



NOTE: Totals may not add due to rounding.

for cleaner food facilities, nutrition education, and more discipline in lunchrooms. Following implementation of measures concerning the study, plate waste was reduced significantly, although it was still a problem. Greater detail of these and other studies are available in our previously cited report, "The Impact of Federal Commodity Donations on the School Lunch Program."

The report also notes that many advocated solutions to plate waste require actions at the State and local level rather than at the Federal level. The principal solutions suggested include:

--Providing nutrition education as part of the school curriculum and promoting better student attitudes toward the school lunch program.

--Providing greater food variety and more attractive lunches.

--Improving lunchroom facilities and atmosphere.

According to program officials contacted, application of some of the solutions reduced plate waste, but additional actions must be taken. Some solutions, however, are dependent on the availability of funds.

The report, in part, recommends that the Secretary of Agriculture

--undertake greater promotion of nutrition education as a part of school health programs as one means of trying to reduce plate waste and

--make greater efforts to encourage State and local school authorities to improve school lunchroom facilities and atmosphere.

In response to our report, the Department of Agriculture stated that it generally agreed with our conclusions and findings. With respect to nutrition education, USDA notes that it lacks legislative authority to require nutrition education as a part of school health programs although it does strongly encourage local school districts to include such activities in both classrooms and lunchrooms. USDA is prohibited under section 12(c) of the National School Lunch Act (42 U.S.C. § 1760(c) 1970) from imposing any requirement relative to teaching nutrition to school children. Regarding lunchroom facilities, USDA states that since

CHAPTER 4

LOSS IMPLICATIONS FOR FEDERAL EXPENDITURES

There is considerable Federal involvement in feeding people through programs, such as the National School Lunch Program and food stamps, both handled by the U.S. Department of Agriculture. The military administers the feeding of service personnel, and the Veterans Administration its hospital system. It is important to examine the potential implications of food waste on the efficiency of Federal moneys spent for food under these programs. To accomplish this we have chosen to discuss several programs.

NATIONAL SCHOOL LUNCH PROGRAM

Our reports address plate waste

Our recent report, "Impact of Federal Commodity Donations on the School Lunch Program," (CED-77-32, Jan. 31, 1977), in part, discusses plate waste in the school lunch program. According to the report, Federal cash subsidies for that program were $1.5 billion and commodity donations were $433.5 million in school year 1975-76. The report also stated that officials at each level of the school lunch program recognize plate waste as a problem. Some prevalent causes of this waste are

--lunchroom atmosphere and conditions which affect students' desires to eat their lunches;

--lack of nutrition education, resulting in students not knowing the value of nutrition for their well-being and not being encouraged to eat nutritious foods; and

--type of food served, including lack of menu variety, serving limited-appeal commodities, offering unfamiliar foods to children, and preparing familiar foods in an unfamiliar manner.

According to the report, studies of plate waste have been limited although several have been or are being made. One study, in California, involving measuring the effect of a comprehensive nutrition education program, showed a 13-percent reduction in plate waste as a result of the program. A second study, in Philadelphia, showed the need

superficial conclusions or to suggest definitive remedies.

"Although few studies are available to use as a basis for comparing food waste in schools with other group feeding situations, the literature available indicates that the degree of waste is within the same range in all group feeding situations reported."

PLATE WASTE RESULTS IN SUBSTANTIAL LOSSES OF FEDERAL FUNDS

In fiscal year 1977 Federal obligations for USDA feeding programs in an institutional setting, including cash grants to the school lunch program, school breakfast program, summer feeding program, child care food program, special milk program, and the value of commodity grants for elderly feeding, direct distribution to institutions and food donations program, totaled an estimated $2.8 billion. Of this, about $1.8 billion represents food purchased with Federal funds. Our reports and USDA testimony indicate that plate waste is generally considered to be a problem. We found no USDA data on the value of loss, although some USDA data has been developed on the proportion of loss for various commodities. At a $1.8 billion funding level, each 1 percent of plate waste would equal an $18 million value of food lost. Even a low level of loss would consequently result in a considerable dollar loss of food purchased with Federal funds. Using the 15-percent loss rate developed in the recent USDA study of plate waste previously cited and assuming a one-to-one relationship between quantity and value loss to estimate dollar loss, plate waste in these programs would have a value of $267.5 million.

FOOD STAMPS

Coupon allotment includes waste factor

The coupon allotment for the Food Stamp Program is based on the thrifty food plan developed by the Consumer and Food Economics Institute, Agricultural Research Service, U.S. Department of Agriculture. This plan is the least costly of four developed by USDA, each of which "specifies the amounts of foods of different types (food groups) that families might use to provide nutritious diets for family members." Each plan contains an allowance for some discard of edible food

Federal Nonfood Assistance Funds are restricted to food service equipment procurement and since no funding for building acquisitions, updating, or improvements are authorized, its role must be one of encouragement and guidance. USDA now notes that it has implemented several of the recommendations.

Our other two recent reports, "The National School Lunch Program--Is It Working?," PAD-77-6, issued July 26, 1977, and the "Summary of a Report: The National School Lunch Program--Is It Working?," PAD-77-7, issued July 26, 1977, which is a summary of our previous report, also, in part, discusses plate waste. The reports note that the type A lunch, the current meal standard for the program, is often presented in a form which contributes to food waste. This viewpoint was expressed by some State School Food Service Directors in testimony before the Senate Select Committee on Nutrition and Human Needs in 1975. One of the recommendations of the reports, made to the Secretary of Agriculture, calls for determining the nutritional standards needed for the National School Lunch Program and, if found desirable, revising the programs meal regulations to, among other purposes, reduce plate waste. USDA, in commenting on the two reports, stated that it shared our concern about plate waste. USDA now notes that as a result of a recently completed review of the National School Lunch Program it has recommended meal pattern revisions which are about to be proposed for general rulemaking. It anticipates the revisions could decrease plate waste.

USDA TESTIFIED THAT DATA IS SPARSE

USDA officials, in testimony before the Subcommittee on Elementary, Secondary, and Vocational Education, House Committee on Education and Labor on March 17, 1977, noted that meals which have been prepared and served, yet remain uneaten, result in an ineffective use of both food and dollar resources. USDA is currently preparing a report to the Congress on plate waste, mandated by Public Law 94-105. The officials also stated that a literature review contracted for by USDA revealed that:

> "The literature on school plate waste and, indeed, institutional plate waste of any sort, is on the whole sparse, anecdotal, journalistic, and not up to scientific standards. A general impression that waste is a problem is conveyed. The data is, however, inadequate to draw more than

expenditure. At the $4,979 million funding level, each 1 percent of waste would equal $49.8 million in Federal funds obligated for food stamps in fiscal year 1977 being used to purchase food that was ultimately discarded. Using the Tucson data and the USDA factor, loss would represent $134.4 million and $249 million, respectively. Each of these figures represents an estimate, necessitated by the lack of any comprehensive study, based on different data.

without jeopardizing the nutritional quality of the diet. USDA told us that the discard levels used were fairly arbitrary. The USDA publication, the Thrifty Food Plan, notes that such allowance is believed necessary because some edible food is discarded in most homes in the preparation of food, as plate waste or due to spoilage. The Thrifty Food Plan includes an allowance of 5 percent for the discard of edible food in that the nutrient levels in the plan are 5 percent above the recommended dietary allowance. Food stamp levels are correspondingly funded at 105 percent of the recommended nutrient levels, which includes a 5-percent waste factor.

It should be noted that USDA officials believe food stamp recipients in reality get less than 100 percent of the recommended dietary allowance. The best data currently available shows that over half of the recipient families are not getting two-thirds of their recommended dietary allowances. In addition, sales tax where applicable is not figured into the food stamp purchases which takes up, at least, some of the 5 percent excess. USDA noted that since the 5 percent is on a recommended dietary allowance rather than a cost basis, recipients would get lower prices when purchasing marginally larger quantities.

Almost no study of waste by food stamp recipients

USDA officials told us that no work was being done in the area of food waste by food stamp recipients. The only material available was the discard allowance in the Thrifty Food Plan. The most current study (concerned with household food waste) outside USDA is being conducted at the University of Arizona at Tucson and is known as Le Project du Garbage. One small part of the study addresses food waste in eight Tucson households that were food stamp recipients. Those eight households had food loss of 2.7 percent of total food input in 1975, considerably less than the all-sample-households level of 11.3 percent. The study notes that policy decisions cannot be based on these figures due to small sample size. We were unable to identify any other studies of food waste by food stamp recipients.

Federal dollar losses could be large

Fiscal year 1977 obligations were an estimated $4,979 million for the bonus cost of food stamps. The bonus cost is the difference between the purchasing power of food stamps and the amount the recipients pay for them, i.e., the Federal

ARS Base Program on Food Losses (harvest to consumer) (note a) Based on Total Agency Budget Base Report FY 1977, 10/1/77

NRP	Title	Research	Scientific years
20190	Crop mechanization	$ 903,269	14.4
20510	Technology for food and feed uses--fruits and vegetables	258,150	1.4
20520	Technology for food and feed uses--field crops	0	0
20530	Technology for food and feed uses--animal products	118,821	1.8
20580	Technology for marketing--fruits, vegetable seeds, nursery, and floral products	3,261,086	51.5
20590	Technology for marketing--field crops	558,027	6.8
20600	Technology for marketing--livestock and animal products	362,542	4.0
20610	Technology and facilities for marketing cross commodities	200,233	2.9
20620	Technology for marketing--insect control	4,005,842	57.1
20660	Transport and quality maintenance systems for overseas marketing of agricultural products	376,374	4.6
		$ 10,044,344	144.5
	Total for ARS	280,589,000	2,972.0

a/Determined by examination of individual projects within each NRP.

CHAPTER 5

EFFORTS TO REDUCE LOSS

Opportunities to reduce loss exist through greater research efforts, the demonstration of new technology to business and industry to speed its implementation, and the education of consumers in food safety, storage, and preparation. Current efforts in these areas appear to be limited.

RESEARCH TO REDUCE LOSS

Research can serve to develop new crop strains, equipment, and procedures which would result in reduced loss. Two advisory groups, established in 1975 to prepare an agenda for the White House Office of Science and Technology Policy, developed a list of policy issues. The list included food as one of the areas which merited the most urgent attention, with emphasis on losses that occur in transportation, storage, and processing.

Within the Department of Agriculture, the Agricultural Research Service has a basic mission to provide the necessary knowledge and technology so that farmers can produce efficiently, conserve the environment, and meet the food and fiber needs of the American people. Its research activities cover a wide variety of subjects, including crops, livestock, poultry, marketing, and nutrition. Some of this work is in the area of loss. At our request ARS has provided us with information it has identified on research in process at the beginning of fiscal year 1977 on food losses dealing with any areas from harvest to consumer. This is based on its examination of individual projects within each National Research Program (NRP). The information contains the NRP number, subject area title, research dollars, and staff scientific years. The data is as follows:

protective services. Since railroads handled only 17 percent of fruits and vegetables and about the same for meats and frozen food, total transport losses related to refrigeration probably exceeded this figure. These were only claims paid. Losses undetected or denied undoubtedly far exceeded this value. Over 500 refrigerated cargo containers for overseas shipment of perishables have been built utilizing this concept, but domestic application has been slow due to replacement rates, patent positions of manufacturers, and lack of understanding of the need by equipment purchasers.

--Retail store sanitation. Several studies have been conducted by ARS on the effect of improved sanitation on reducing losses and maintaining product quality with emphasis on handling fresh meats. In retail food stores improved sanitation and temperature control for fresh meat can make considerable operational savings ranging from 0.5 to 1.5 percent of retail meats sales. These savings, projected nationally, would range from $157 million to about $500 million annually. The addition of 1 day of shelf life to meat is calculated to be worth 3.5 to 4.5 cents per pound to beef marketing. This research has shown that good sanitation and refrigeration will prolong the shelf life 2 to 5 days and even longer with very good handling practices. Considerable economies lie in reorganization of the present meat distribution system, moving meat-cutting functions from the store to a central system. In other areas at the retail level, ARS has developed a set of guidelines and procedures for a total store sanitation program. In the produce department, improved operating procedures have been developed, including sanitation which, if adopted, could reduce 1 to 2 tons of produce waste thrown out each week at each supermarket. These studies have been completed; and the information is available, and yet it has not been picked up and implemented by the industry. The application of these systems requires management's attention, training of personnel, improved maintenance of equipment, and similar actions which management often does not perceive as directly contributing to profit. Additional demonstration, education, extension, and training sessions are needed to inform industry as to how the potential savings could be obtained.

--Hydraircooling peaches. Loss from decay and deterioration during the transport and marketing of fresh peaches can be prevented by precooling, waxing, and

Loss research, as detailed above, represented 3.6 percent of total ARS dollars and 4.9 percent of total scientific years.

Current Research Information System indicates limited food loss research

The Current Research Information System (CRIS) is a data base on research projects maintained by the Cooperative State Research Service (CSRS), U.S. Department of Agriculture. Coverage includes active and recently completed projects (terminated less than 2 years ago) from 56 State Agricultural Experiment Stations, 30 Forestry Schools and other cooperating institutions, and 6 U.S. Department of Agriculture research agencies. Projects are retained in CRIS until an official termination report is received, even if it goes beyond the estimated termination date.

At our request a search was made of about 24,000 research resumes in the CRIS data base to identify projects dealing with food loss in harvesting, marketing, transportation, storage, distribution and/or households. Generally, CRIS searches are broad in order to reduce the risk of missing projects of peripheral interest. One-hundred and seven out of approximately 24,000 research resumes dealing, at least in part, with food loss were identified in CRIS. Of these, 46 were undertaken by CSRS, 59 by ARS, and 1 each by the Statistical Reporting Service (SRS) and the Economic Research Service (ERS). The ARS projects are included in the budget and scientific years figures discussed above. CRIS was not able to provide data on staff or budget allocated to each project.

DEMONSTRATIONS OF NEW TECHNOLOGY

In a number of instances, research has been conducted which could lead to a reduction in food losses. Industry has adopted some of this research which serves to reduce loss. Other research has not been used despite results which indicate a reduction in loss and considerable dollar savings. At our request the ARS has compiled several examples of research it has conducted which industry has not implemented. These examples, with ARS comments on why they have not been implemented, are:

--Transportation refrigeration. ARS has developed a system of flow delivery of refrigerated air which not only reduces product losses by 50 to 100 percent but also saves in transport cost by permitting heavier loading. In 1975 perishable food loss claims paid by American railroads were about $32 million, of which two-thirds were directly related to refrigeration and

high degree of success. This equipment has not been adopted for the following reasons:

--Ability to sort a seasons' crop into adequate groups without additional bruising has not been demonstrated.

--Developmental costs are high for equipment of this sophistication, and repair personnel are not available. Delays, due to breakdowns for more than a few hours, would cause considerable problems and loss for any one packinghouse.

--Present equipment in use in the industry is probably not over 50 percent amortized. Adoption of light transmission equipment would mean replacing at least a portion of this and adding additional financial encumbrance to the packing plant.

According to several officials, ARS was not active in demonstrating its research results due to

--a lack of funds,

--the high cost of demonstrating some research on a commercial scale, and

--a consideration that its emphasis was not on the promotion of research results.

In the past demonstrations had been done in some subject areas, resulting in industry implementing new research findings in its operation. Without demonstrations, with industry taking the lead, implementation of loss reducing research could take 10 or 20 years according to one ARS researcher.

Extension Service efforts

The Extension Service is the educational agency of the U.S. Department of Agriculture. In cooperation with the land grant universities and county governments, the Service disseminates the latest technology developed by research. With research results having implications for business and industry, agents meet with company officials and provide them with information on new developments, usually in the form of published research reports. Demonstrations of new equipment and procedures are conducted at times. The Service has no funds available for research. If laboratory research indicates that losses can be reduced but the development work for commercial-scale demonstration has not been done, the

treating them with fungicides. A surface application of the proper fungicides suspended in an emulsified wax solution will considerably reduce decay and weight loss when accompanied by precooling to at least 40° F. For precooling to be most effective, it must be done as a final operation in the packing line, immediately before loading onto transport vehicles or into cold storage. Hydrocooling has long been the popular method for precooling peaches. However, because of its propensity to wash the fungicide-wax application off the fruit surface and its tendency to recontaminate the fruit with decay causing micro-organisms, its use reduces the effectiveness of the wax treatment. Tests have shown that hydraircooling, a precooling method that uses a mixture of air and water spray as a cooling medium, causes less washoff of surface treatment than hydrocooling and produces negligible recontamination. Compared to conventional hydrocooling, hydraircooling reduced decay from 3.6 to 0.8 percent and weight loss from 6.9 to 5.4 percent during simulated transit and distribution studies. In terms of total value, on today's market, this amounts to a net annual savings of about $15 million. Hydraircooling has not been adopted by industry because its potential as a practical commercial-precooling method has not been sufficiently demonstrated.

--Sorting apples by light transmission. A yearly average of about 9 million boxes of apples goes to processing as opposed to the fresh market from the State of Washington alone. This represented an approximate $60 million loss, based on the average processing price of $80 a ton and an average fresh market price of $8 a box. Each spring about 9 million additional boxes are sold to the fresh market at an average of $2 below current value because of mixed maturity. This is an additional economic loss of $18 million. About 1 to 5 percent of apples are estimated lost at retail. While there are probably several reasons for this loss, a major portion of it could have been avoided if the apples had been sorted into uniform color and maturity and then marketed in their proper sequence of storage life. Conservatively speaking this would mean a saving of 300,000 boxes. Light transmission techniques and equipment have been developed and tested that could sort these apples and prevent these losses. This is done by sorting into groups according to storage potential and then following a proper marketing order. Pilot fruit sorting lines have been operated with a

CHAPTER 6

SOME IMPLICATIONS OF LOSS

The material in this report indicates that food loss in the United States is substantial. This loss has a variety of implications, in addition to those already discussed, which merit discussion.

RELATIVE LOSSES

On an absolute basis, our estimates indicate that food loss is substantial. To place it in perspective, food loss should also be examined in terms of production. It may be considered in terms of our total output, regardless of whether production is for human, animal, or industrial use. Based on that definition, available data indicates a loss of 20 percent on a weight basis. This is obtained by dividing total loss by food available for harvest. If loss is viewed on the basis of that part of food produced for human consumption that is ultimately lost, the proportion rises to 21 percent. This is obtained by dividing loss of food produced for human consumption by food, i.e., excluding feed, available for harvest.

CONSERVATION POTENTIAL IS LARGE

In crop year 1974 U.S. farmers planted 331 million acres to produce food. In addition, they used 45 million tons of fertilizer as well as considerable amounts of water, energy, and many other inputs. The food system consumed a total of 2.3 billion equivalent barrels of oil. Countless other inputs were used at each additional stage of the food system. Relating all food loss to the farm resources allocated to producing food, we estimate that 66 million acres of land were used to produce food that was ultimately lost, either at some stage of the food system or by the consumer. An estimated 9 million tons of fertilizer were similarly used to produce food ultimately lost. In energy, an estimated 461 million equivalent barrels of oil were consumed on food ultimately lost. Added to this are all the other inputs allocated the food system which were also lost, along with the food product.

IMPACT ON HUNGER

Based on the average daily caloric intake of a U.S. citizen, we estimate that the combined loss of U.S.-produced food grains, meat, sugar, oilseeds, vegetables, fruits, and nuts in 1974 could have fed an estimated 49 million people.

decision on how to proceed would be left to the county extension agent. The Service is more oriented toward the farmer and, in addition, does considerable work in reaching the consumer on food safety. There are no records kept on the time spent by type of group, i.e., industry, farmer, consumer, so it is not possible to say what level of effort is oriented to disseminating research results of potential interest to industry, much less to results of research on food loss.

ACTIVITY RELATING TO HOUSEHOLD FOOD LOSS

In a presentation on USDA Family Food Plans, 1974, at the 1975 National Agricultural Outlook Conference it was noted that little information is available about the amount of edible food discarded in households during preparation, as plate waste, or because of spoilage. USDA told us that the most recent study of household loss conducted in the Department was "Discard of Edible Food in Households" issued in 1963. In essence, currently no work is in progress at USDA on consumer food loss, although we were told that two or three States are preparing to do work in this area. The only activity we have been able to identify directly dealing with household loss is the previously cited University of Arizona at Tucson work, which has received some funding from the National Science Foundation. USDA also stated that in years past its food consumption surveys tried to obtain data from consumers on household loss but that these efforts produced too little data to be of use; as a result, these efforts were discontinued. New methodology is believed necessary to measure household loss in consumer surveys, notwithstanding the Tucson work in measuring discarded food in garbage. With respect to the Tucson work, we were also told that there was a need to study some other geographic areas to determine whether their data is representative of other parts of the country.

USDA has issued a number of publications concerning storage of various foods, home canning, and freezing. While the major focus of these publications is food safety, with emphasis on avoiding food borne illness, they do contain information on handling and storage practices which would reduce household loss. However, we were told that USDA has no publication whose primary focus is reducing household food loss.

a processor who did not wish to incur the costs of carrying them. The group was able to pick the potatoes up and distribute them directly to the recipients. A second example involved a field of about 65 million pounds of potatoes. The farmer had been told by a processor that it could not use them and had no other market for them. In this instance the offer could not be utilized because the logistics could not be arranged to handle the crop before frost destroyed it.

If channels were to be established to gather and distribute otherwise lost food, a number of points would have to be addressed. These include

--which groups and individuals the food would go to,

--how it would be harvested and channeled, and

--avoidance of damage to the crop producing plant.

EFFECT OF TAX POLICY ON CHANNELING FOOD TO THE NEEDY

Testimony before the Senate Finance Committee, 94th Congress, indicated that the tax law, as amended in 1969, was having an effect on donations of appreciated property, such as food, to certain charitable organizations. Although the Washington State group indicated that farmers were willing to open their fields to gleaning, it is important to examine the effect of tax policy on channeling food to the needy at a national level.

Pre-1970 law

Prior to the enactment of the Tax Reform Act of 1969, farmers' donations of crops they raised to a qualified charity were treated as charitable contributions of the fair market value of the property at the time of the gifts. This type of property is called "income producing property." Income-producing property generally appreciates in value for some reason while held by the donor (i.e., the growing crops become more valuable as harvest approaches, a finished painting is more valuable than its components), but the holder has not realized the benefit of such appreciation so that it would be appropriate to tax that value. Neither the harvesting nor the donation of crops is considered an appropriate action upon which tax should be imposed. No taxable event having occurred, taxable income is not realized. So, when farmers donated this property to a charity, they were entitled to deductions based on its appreciated fair market value, but were not liable for any income tax. Thus, the allowable deductions and subsequent tax savings, in many instances,

We and the World Food Conference emphasize impact on hunger from reducing loss

Generally food loss is believed to be more substantial in other countries, particularly the less developed countries. This has particular significance for world hunger. Our recent report "Hungry Nations Need to Reduce Food Losses Caused by Storage, Spillage, and Spoilage," (ID-76-65, Nov. 1, 1976), concludes that a tremendous opportunity exists for increasing the food supply in the developing countries by reducing post-harvest losses. The report also notes that in May 1967 the President's Science Advisory Committee reported that if only half of the estimated world loss of food grains were prevented there would be an additional 55 million tons, enough to make the diet of 500 million people in developing countries adequate in total calories. The World Food Conference, also cognizant of the implications of loss, noted that in many developing countries large quantities of food are lost between the farm field and the consumer and that the deterioration in the nutritional value of food before it reaches the consumer is a serious problem. In Resolution I the Conference requested, among other things, that all countries reduce to a minimum the waste of food and agricultural resources, in particular land, water, and all forms of energy.

CHANNELING LOSS TO THE NEEDY

A substantial portion of food loss is safe, nutritious food that would be consumed if it could be recovered and routed to recipients. One possible avenue to making effective use of this loss would be to channel it to the needy. With respect to loss at harvest, a possible primary food source, labor would be required to glean the harvested field and transportation would be required to move the food to the recipients.

In Monterey County, California, one senior citizens group is picking up about 4 tons of vegetables a week. Other groups are also involved in channeling food that would otherwise be lost to the needy. One group, in Washington State, has been in existence for 6 years. This group has a mechanism in place that permits it to obtain surplus food when available and distribute it to those in need. The spokesman for the group stated that most farmers feel guilty about food left in the field and are interested in insuring that food does not go to waste. As a result, they are willing to provide such food to appropriate groups. Food also becomes available from processors and shippers. The essential element is to have a logistical infrastructure available to pick up and distribute the food. Recently, for example, this group was offered 60,000 pounds of frozen french fried potatoes by

charitable contributions deduction was not meant to provide an after-tax benefit so close to, or even greater than, the after-tax benefit that would be realized if the item were sold for a profit. With such a substantial tax benefit as the law then allowed, the Committee believed that the attractiveness of the tax savings, not charity, was the motive for the contribution.

1969 revision

To equalize the treatment of contributions of cash and appreciated property, the 1969 Tax Reform Act added section 170(e) to the Internal Revenue Code of 1954. This provision, among others, limited the charitable contribution deduction to the fair market value of the appreciated property at the time of the donation minus an amount which, if the property were sold, would be treated as ordinary income or short-term capital gain. Since the proceeds of a sale of previously unharvested crops in the hands of the farmer-growers constitutes ordinary income, this amount is deducted from the fair market value of the crops to determine the allowable charitable contribution deduction. This means that generally there is no allowable charitable deduction at all for donated crops, since the proceeds of the sale of crops, if sold, and the fair market value of those crops are the same.

The farmer is presently allowed, as an ordinary and necessary business expense deduction, the costs and expenses of producing the donated property. This seems to be the only tax benefit left for farmers who donate harvested crops to charities after the 1969 Tax Reform Act. Thus, the windfall deductions described above are no longer available and, the strong encouragement to donate this property to charity no longer exists.

Present law

The rule enacted in 1969 not only eliminated the abuses we have examined but apparently resulted in diminished contributions of appreciated property to certain charitable organizations, especially those providing food, clothing, and medical products to the needy. This led some groups to call for changes in the law to reintroduce an allowable deduction based, at least in part, on the appreciated (yet unrealized) value of the donated property.

The Senate Finance Committee agreed that certain modifications in the law were needed to accomplish that purpose. According to the Committee's report:

exceeded the donors' comparatively minimal costs to produce the items. In fact they often were raising a net tax deduction rather than a net tax liability. If they chose, the taxpayers were allowed a business expense deduction, limited to the costs of producing the items, usually less than the fair market value of the fully grown crops. Both the business and charitable deductions were allowable simultaneously, entitling the farmers to multiple benefits.

According to the congressional committees that considered the 1969 Tax Reform Act, this situation caused two serious inequities. First, it allowed a greater tax deduction for this type of appreciated property than for a similar contribution of cash. Because of the income-producing property concept described above, this allowed unrealized appreciation of certain assets to go untaxed, yet be taken into account for purposes of allowing a charitable contribution deduction. Since cash does not appreciate, two classes of property available for contribution, each treated unequally, were available for donation under the law, producing inequitable results.

For example, compare the pre-1970 tax benefit of a $50 cash contribution for a taxpayer in the 70-percent bracket (i.e., $35: 70 percent of the $50 contribution), with this example posed by the House Ways and Means Committee in its report:

> "* * * Thus, in some cases it actually is possible for a taxpayer to realize a greater after-tax profit by making a gift of appreciated property than by selling the property, paying the tax on the gain, and keeping the proceeds. This is true in the case of gifts of appreciated property, which would result in ordinary income if sold, when the taxpayer is at the high marginal tax brackets and the cost basis of the ordinary income asset is not a substantial percentage of the fair market value. For example, a taxpayer in the 70-percent tax bracket could make a gift of $100 of inventory [read harvested crops] ($50 cost basis) and save $105 in taxes (70-percent of the $50 gain if sold, or $35, plus 70-percent of the $100 fair market value of the inventory, or $70)."

Thus, for the same $50 cost one asset nets a $35 benefit, while another, with the same cost basis, nets a $105 benefit.

The Committee believes that cash gifts and those of appreciated property should be treated equally and that any contrary result was unintended. It also thought that the

ARE LOSSES ECONOMICALLY JUSTIFIABLE?

From a business standpoint, the value of food product saved for human use should be equal to, or greater than, the cost of saving it. To the extent that costs exceed value, good business judgment dictates that the loss is an acceptable economic cost. In the course of preparing this report, no material has been found that would indicate that opportunities were knowingly being overlooked by business owners to conserve food at an acceptable cost. The profit motive should dictate against such loss. The slowness of technology transfer, however, can serve to impede the implementation of loss-reducing techniques. It is, therefore, possible that opportunities to make loss physically and economically preventable are not being utilized. In sum, at this point losses that have been identified are, for the most part, economically justifiable.

CAN LOSS REDUCTION BE GOOD BUSINESS?

As previously discussed, most food loss is considered to be economically justifiable. As economic conditions change and new requirements, particularly in the area of pollution control, are imposed, it may become good business to reduce loss. For example, tomatoe processing historically used large quantities of water and discharged lost food material, principally skins and adhering pulp, into nearby rivers and streams. Antipollution rules have now precluded this technique of waste disposal. ARS, in cooperation with the processing industry, has developed a dry caustic peeling method for tomatoes which largely eliminates pollution while greatly reducing loss. The process also requires considerably less water.

Attention has also been focused on food waste fermentation, according to reports in a trade magazine. A recent article notes that the process of fermentation, carried out by bacteria, yeast, and molds, has been used since antiquity to preserve and improve food. Recently, the use of the single cell organisms themselves as food has developed as a potential new source of food through growing single cell protein on petroleum and other hydrocarbons. An alternative to using these high cost feed stocks is food waste, which is abundant and cheap. The key factor in making waste a desirable alternative appears to be pollution control. Rather than spending considerable sums of money on pollution control, that money could be channeled into the necessary waste fermenting equipment. This use of food waste would have the advantage of being subsidized by money that might have been spent to conventionally treat it. There are several firms around the world engaged in food waste fermentation. This

"Reasons for change

"The rules that provide that the donor of appreciated ordinary income property can deduct only his basis in the property have effectively eliminated the abuses which led to their enactment; however, at the same time, they have resulted in reduced contributions of certain types of property to charitable institutions. In particular, those charitable organizations that provide food, clothing, medical equipment, and supplies, etc., to the needy and disaster victims have found that contributions of such items to those organizations have been reduced.

"The committee believes that it is desirable to provide a greater tax incentive than in present law for contributions of certain types of ordinary income property which the donee charity uses in the performance of its exempt purposes. However, the committee believes that the deduction allowed should not be such that the donor could be in a better after-tax situation by donating the property than by selling it."

The Committee adopted revisions to enable a corporation (other than those corporations that are treated by the tax laws similarly to partnerships) to take a deduction for the total of its basis (generally its cost to acquire the property) in the contributed appreciated property (inventory and property held for sale or exchange in its business) plus one-half the unrealized appreciation; with a ceiling of twice its basis. Only property donated to charities for free distribution to infants, the needy, and the ill are eligible for this special treatment. This provision was adopted by the conference committee and later enacted into law.

The ceiling of twice the basis of the donated property assures that, at present tax rates, the tax benefit of the donation will not exceed the donor's basis. This is because the maximum corporate tax rate, 48 percent, multiplied by twice the basis, equals a maximum tax benefit of almost, but not more than, the taxpayer's entire basis in the property. If this provision were to be extended to individuals it would have to be modified to reach the same result. Since the maximum individual tax rate is presently 70 percent, a deduction of twice the property's basis would yield a tax benefit of more than the property's basis. Such a situation would allow the same abuses that led to the 1969 revision of the law.

COST OF LOSSES BORNE BY CONSUMER

Consumers ultimately bear the cost of losses in the form of higher prices. This is due to factoring anticipated loss into cost and hence, the pricing structure. Such anticipated loss is based on prior experience. To the extent that unanticipated loss occurs, this is not factored into costs and must be absorbed by the firm incurring the loss. This does not apply to crop shortfalls, which reduce supply and increase price. It was not possible at this time to estimate the cost of food loss to the consumer.

underlines the possibility that loss reduction may be good business rather than economically unjustifiable in at least certain instances.

Need to balance any improved yields with demand

Increases in the supply of food at the farm level have a depressing effect on prices. A given percentage increase in supply will generate a substantially greater decline in farm prices. As a result, farm income may be greater from a smaller crop demanding a higher price than from a larger crop having a lower price. From the farm standpoint any increase in yield resulting from a reduction of loss would have to be balanced by an increase in demand sufficient to absorb the greater output or by a decrease in total production to maintain supply at current demand levels. Otherwise, USDA notes that there could be a problem with inelastic demands (price and income) and with possible substantial increases in public costs of farm commodity programs either to store excess production or to subsidize exports of those commodities in surplus.

NUTRIENT LOSS AN IMPORTANT FACTOR

There is another kind of loss in addition to physical loss. This is a decline in the nutritive value of food. Nutrient loss occurs in many ways. Heating destroys certain vitamins, washing and peeling removes various nutrients, and storage results in the decline of certain nutrients. The result is often less nutritious processed products. Recent USDA studies indicate U.S. consumption is adequate to excessive from the standpoint of protein and calories, yet often is deficient in essential nutrients. Their estimates claim that about half of all households fail to meet the recommended dietary allowance for one or more nutrients and that one-fifth of families' diets provide less than two-thirds the recommended dietary allowance for one or more nutrients.

By way of illustration, one important nutrient is vitamin C. Fruits and vegetables are the source of 94 percent of vitamin C in the diet of families in the United States. Losses of vitamin C have been reported during storage. Vegetables such as kale, collards, turnip greens, spinach, rape, cabbage, and snap beans, which lose moisture readily and wilt appreciably, tend to lose vitamin C more rapidly than those resistant to wilting. This, of course, contributes to loss of nutrients to the consumer, who must consume food to satisfy nutritional needs.

With respect to food stamps, a 5 percent allowance for food discard is contained in establishing benefit levels. Fiscal year 1977 estimated obligations for the bonus value of food stamps were $4,979 million. Each 1 percent of loss at this level would result in $49.8 million in lost food. At the 5-percent allowance, loss based on the fiscal year 1977 estimated bonus value would total $249 million.

Research to reduce loss has been small. Information supplied us by USDA indicates that the level of resources devoted to loss related research has been small. A search of the Current Research Information System, which contains about 24,000 research resumes covering six USDA agencies and a large number of other institutions, yielded only 107 resumes dealing, at least in part, with food loss. An examination of research in progress by the Agricultural Research Service indicated that 3.6 percent--$10 million--of its budget base and 4.9 percent--144.5 scientific years--of total scientific years at beginning of fiscal year 1977 were in the area of food loss. In our report "Management of Agriculture Research: Need and Opportunities for Improvement," (CED-77-121, Aug. 23, 1977, we recommended, and USDA agreed, that ARS should identify and document the relative priorities of each national research program and of each problem and research need within the program areas.

Consumer waste of food is a serious concern receiving little attention. Consumer disposal of edible food in households totaled 21 million tons of food valued at $11.7 billion. Despite this there is little information on the discard of edible food in households and its causes. The only recent work that has been done in this area is at the University of Arizona in Tucson. It is not known if the study, which encompasses only Tucson, is representative on a national basis. There is also no USDA material available whose primary focus is reducing household food loss. However, USDA has a number of food safety-oriented publications that contain information on handling and storage practices that would reduce loss.

Food loss places several burdens on society. It carries a price tag, which is largely borne by the consumer, to the extent that currently anticipated but economically unavoidable loss is a cost of production. Significant resources devoted to producing that portion of food subsequently lost represent a nonoptimal allocation of a number of scarce resources, including land, water, and

CHAPTER 7

CONCLUSIONS AND RECOMMENDATIONS

Food loss in the United States has been estimated to be of considerable magnitude, although there is a lack of comprehensive systemwide data on it. Every segment of the food system is affected, with important implications for both the efficiency of Federal expenditures and the conservation of resources. The subject has been given insufficient attention, a situation which calls for remedial action.

CONCLUSIONS

There is a lack of comprehensive systemwide data on U.S. food loss. Existing data is limited to specific commodities at specific points in the food system. In many instances data is based on the best judgment by experts in the field. Data is also nonexistent in some areas. Consequently, a broad assessment of food loss must be based on a mix of actual data, estimates, and projections. This report has been conservative in its choice of estimates so the magnitude of loss, if anything, is likely to be understated.

Food loss is substantial and touches all segments of the food system. It extends throughout the food system, but is heaviest at the harvest and consumer level. On an absolute basis, we estimate that 1974 loss totaled an estimated 137 million tons of food with an approximate value of $31 billion. On a relative basis, loss among all commodities, from farm to consumer, comprised 20 percent of the food initially available for harvest. Of the food grown primarily for human consumption, i.e., excluding both production and loss of feedstuffs, 21 percent, or more than one-fifth, was never consumed by people. Some was lost at every level, beginning at the farm and extending through to the consumer.

Food loss has important implications for the efficiency of Federal expenditures. Substantial Federal expenditures are made for food under a variety of programs. The uneaten portion of meals purchased with Federal funds results in an inefficient use of both food and dollar resources. Plate waste is recognized to be a problem in the National School Lunch Program. Available literature indicates that the degree of waste is within the same range in all group feeding situations. Within USDA, fiscal year 1977 estimated obligations for feeding programs in an institutional setting totaled $1.8 billion. Each 1 percent of waste at this level would equal $18 million in lost food.

--review the priority given research activities devoted to loss reduction as part of the broader overall assessment we have previously recommended;

--determine, on a national basis, the extent and causes of household waste and undertake broad educational efforts to the extent that causes are related to lack of knowledge of such subjects as food safety and efficient meal planning; and

--review opportunities for encouraging charitable donations of food that would otherwise be wasted, such as by extending the same tax benefits to unincorporated farmers that are already available to incorporated ones or by an equally effective alternative program.

AGENCY COMMENTS AND OUR EVALUATION

The Department of Agriculture states that the report identifies an area that is important and merits more attention in the context of today's problems. USDA concurs that our recommendation to undertake a comprehensive study of both the magnitude and causes of loss is justifiable but given the inadequate data base believes it would be appropriate to hold in abeyance all other inferences and recommendations until the recommended study is completed. We believe that having identified food loss as an important area, it is both appropriate and useful to explore some of its ramifications.

USDA is concerned that the estimates of loss will provide a false impression of waste and the potential value of increased research to reduce it. The report notes that the data had defects but we believe it provides a reasonable overview of loss. USDA does not give sufficient credit to the considerable attention in the report addressing both the availability and reliability of data and the procedures used to arrive at estimates so that the reader can judge them. In viewing the potential value of loss related research, USDA refers to the figures in the reference year and fails to consider the life-cycle benefits of improvements that would reduce loss on an ongoing basis.

With respect to the implications of waste, USDA is concerned with the presentation of the food stamp program waste factor and the estimate of loss for the school lunch and other feeding programs. We have added additional material dealing with the food stamp program waste factor and have made estimates using several loss factors to provide the reader with a broader perspective. Regardless of the waste factor, the conclusion remains that waste has important implications

energy. Opportunities are missed to conserve existing resources by increasing output at any level of inputs.

Losses from farm to retail appear to be based on economic grounds, and as such are difficult to reduce. In most instances the cost of reducing loss is greater than the value of the saved product. Reductions in loss will be dependent upon the extent to which it becomes good business. This can occur through the development and implementation of new equipment and techniques and through the effect of laws and regulations which impose new requirements, such as in the pollution area. These types of developments serve to change the economics of loss. To the extent that they serve to make loss reduction economically viable, reductions should occur.

Tax policy affects channeling food. Prior to 1970, the Federal income tax law regarding charitable deductions strongly encouraged farmers to donate harvestable products to tax exempt charitable organizations. This was eliminated by the Tax Reform Act of 1969. Some of the harsh consequences of the 1969 act have been corrected by the Tax Reform Act of 1976, which reinstated an allowable deduction to corporations for qualified appreciated property donated for use by a qualified charity to provide aid to the needy, the ill, and infants without charge. However, the change does not reintroduce the incentive found in the pre-1970 law for many farmers because they are not incorporated and thus not affected by the 1976 revision.

RECOMMENDATIONS

Food loss is not a subject that lends itself to simple solutions. Its reduction involves significant tradeoffs of sometimes conflicting objectives and poses difficult value judgments. There are, however, a number of areas that could benefit from increased attention. We recommend that the Secretary of Agriculture

--undertake a comprehensive study of both the magnitude and causes of loss to rectify the current lack of knowledge and to focus research attention in the most promising areas;

--determine the extent and causes of food waste (1) among food stamp recipients and (2) in all Department supported institutional feeding programs and take remedial action as appropriate;

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for food stamp recipients and little is known on the subject. With respect to other feeding programs, the report notes USDA testimony that the degree of plate waste is within the same range in all studied group feeding situations. The report does not indicate that the school lunch program is the only institutional food service program having plate waste. In absence of data on dollar losses it was necessary to assume a one-to-one relationship between quantity and value loss. This assumption was noted in the report so that the reader could judge the estimate. We believe it is important to make estimates in order to provide the Congress with an indication of their significance.

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CALCULATION OF LOSSES

To asses the magnitude of loss we pieced together the best information that we could identify, which consisted of published studies, loss rates, and judgments by experts in their fields. Using this data we computed estimates of both quantity and value loss in crop year 1974, the most recent for which broad based data was available. This appendix explains in greater detail how estimates were made and provides several examples for the reader who wishes to have a more detailed insight into our estimation process.

CALCULATION OF HARVEST LOSSES

Harvest loss rates were obtained from publications of the U.S. Department of Agriculture, individual scientific papers by Agricultural Research Service, Statistical Reporting Service, Economic Research Service, and State Cooperative Extension Service personnel, and the expert opinion of knowledgeable industry people. Some of the published loss rate data used was rather dated, going back to the 1965 publication, "Losses in Agriculture." However, after talking with knowledgeable people in the field, we were confident that this data was as good as any currently available. The calculation of the amount left in the field was based on the application of the loss rate to the actual production figures, by crop, as published by USDA. This yielded a figure on crop actually available for harvest in the field. The actual production was subtracted from the estimated crop available for harvest to obtain an estimate of the amount left unharvested in the field. An example of this calculation follows:

		Tons (000 omitted)
Wheat		
Units harvested		53,800
Divided by harvest efficiency	$\left(\frac{53,800}{.95}\right)$	
Yields: units available for harvest		56,632
Loss: units available for harvest		56,632
Less units harvested		53,800
Equals harvest loss		2,832

The value of harvest losses was obtained by subtracting the value of harvested products from our estimate of the value of food available for harvest. Harvested product value was the sum of receipts to farmers for agricultural products as contained in table 612, Agricultural Statistics 1975. Nonfood agricultural products were excluded from the computation. This publication contains preliminary 1974 data. The value of crop available for harvest was computed by multiplying the physical quantity available by the average price received for that commodity at harvest as published in Agricultural Statistics 1975. These individual value figures were then summed to the estimated total value available for harvest.

CALCULATION OF STORAGE LOSSES

Storage loss rates were similarly obtained from publications of USDA, scientific papers, and industry studies. The calculation of storage loss for each crop was a straightforward application of the loss rate to the amount placed in storage, which was assumed to be the harvested amount. Certain fruits and vegetables are sold fresh and hence are not stored. No losses were computed in these instances. An example of storage loss calculation follows:

	Tons (000 omitted)
Wheat	
Units stored (all units harvested were assumed stored)	53,800
Times storage loss rate (.037)	
Equals storage loss	1,991

Data for each commodity was then aggregated to obtain totals. Prices of stored commodities are not maintained and so the value of storage losses was obtained by multiplying the price of the commodity at harvest as previously computed by the estimated physical loss. Individual commodities were aggregated to total storage loss value.

CALCULATION OF TRANSPORTATION LOSSES

Transportation losses were calculated on the basis of commodities leaving storage. Transit loss rates were

obtained, to a large extent, from USDA publications and analysis of the marketing of individual commodities by research organizations. Transit loss was calculated by applying the loss rate to the amount entering the transportation system. An example of the calculation of transportation loss follows:

	Tons (000 omitted)
Lettuce	
Units transported (units harvested)	2,486
Times transit loss rate (.03)	
Equals transit loss	75

Data for each commodity was then aggregated to obtain totals. The value of transit loss was obtained by multiplying the physical loss by the price of the commodity at harvest. As with storage, price data was not available for commodities in transit. Individual loss values were aggregated to obtain totals.

EXPORTS

Food exports were excluded from our computation of loss at the point at which the commodity left the United States. In table 1, for fresh products, this was considered to be after transportation and for processed products, it was considered to be after processing. Although losses are assumed to occur in exported products, they occur after leaving the United States and so should not be considered as part of U.S. losses.

The quantity of exports was based in part on actual export statistics and in part on the apportionment of crops and processed products contained in the distribution of crop by use as published in USDA's Agricultural Statistics, 1975 and Agricultural Statistics, 1976. Export value was based on statistics provided by USDA.

ANIMAL FEED DIVERSION

Animal feed diversion was used to accumulate those amounts of crops or crop products that were used to support the animal feed system rather than directly feed people. Our apportionment of crops to the animal feed system was

based on the distribution of crop by use as published in USDA's Agricultural Statistics, 1975.

CALCULATION OF PROCESSING LOSSES

Processing loss rates were obtained from publications of USDA and the expert opinion of knowledgeable industry people. Loss was determined by the application of loss rates to the amount entering processing. For fruits and vegetables, totals first had to be separated into fresh and processed based on data contained in Agricultural Statistics 1975. Exports of raw agricultural products had to be factored out of the total entering processing. Commodities, such as, rice, which are exported after milling did not have exports factored out before processing.

Data on processing loss is largely limited to sugar and commercial fruits and vegetables whose loss rates have been established by USDA research and other studies of individual commodities. Little data is available for feed and food grains as well as oilseeds. An example of the calculation follows:

	Tons (000 omitted)
Oranges	
Units available	9,170
Export units fresh	347
Domestic units fresh (from USDA statistics)	1,579
Units processed	7,244
Times processing loss rate (.03)	
Equals processing loss	217

Commodity data was then aggregated to obtain totals. Value was calculated by multiplying physical loss by the price at harvest, which is the processor's payment for crop. Individual loss values were then aggregated to obtain totals.

CALCULATION OF ANIMAL SYSTEM LOSSES

Inclusive data on all elements of the animal system is not available. However, a significant portion of the known loss has been summarized by USDA. The losses involve condemnations of cattle, calves, sheep, goats, swine, and horses during the process of meat inspection at slaughter and meat processing plants. USDA's annual summary of the results of its meat inspection activities provides totals of condemned animal food products on a weight basis. Value was obtained by multiplying physical loss by the live weight value.

CALCULATION OF WHOLESALE/ RETAIL LOSSES

Loss rates were not available for a number of commodities because they had lost identity when they were input to processing. This was true for feed grains, food grains, oilseeds, and tree nuts. No calculations of wholesale/retail loss could be established in these instances. Loss rates were only available for fresh fruits and commercial vegetables. These loss rates were averaged and applied to the units input to wholesale/retail coming direct from harvest, such as lettuce, tomatoes, and others where the fresh market is a significant portion. An example of our calculation of wholesale/retail losses follows:

	Tons (000 omitted)
Cucumbers	
Units fresh	217
Times wholesale/retail loss rate (.04)	
Equals wholesale/retail loss	9

We estimated total value loss at wholesale/retail by using a shrinkage rate composed of 2 percent each at wholesale and retail. This was based on our analysis of existing data and the judgment of industry officials, the only information we would locate. Beginning with the USDA figure for consumer expenditures for U.S. farm-produced food--$149.3 billion--which include both at home and away from home expenditures, we constructed an equation

permitting the calculation of the amount entering wholesale/retail prior to applying the shrinkage factor. The USDA reported figure was then subtracted from the estimated value entering wholesale/retail to obtain the loss figure.

CALCULATION OF INSTITUTIONAL LOSSES

Only limited data on loss rates at institutional locations is available. We used the loss rates established in a recent USDA analysis of the National School Lunch Program. The loss rate indicated an overall average by weight of 15 percent of the food was not eaten. This was applied to total food entering institutional channels to obtain a weight loss. The input to the institutional level was determined by apportioning that food available at wholesale/retail between household and institutional based on USDA statistics. Restaurants and institutions were included in the institutional figure and this represents about 28 percent of the total while consumers in households represent about 72 percent. The calculation of institutional losses follows:

	Tons (000 omitted)
Institutional	
Wholesale/retail available	264,700
Times distribution factor (.28)	
Equals input to institutions	74,116
Times loss rate (.15)	
Equals institutional loss	14,230

A 10.8 percent loss rate, which is the household loss rate used, was applied to the value of food entering institutional channels to estimate dollar loss. This lower rate was used to provide a more conservative figure than would result from assuming a one-to-one relationship between quantity and value loss at the considerably higher institutional quantity loss rate.

CALCULATION OF HOUSEHOLD LOSSES

Household loss rates are not available in a national form. Some of the most recent data has been developed by the University of Arizona at Tuscon. Their loss rate for 1974 was 10.8 percent of food entering the household. To provide an estimate of the U.S. loss, we applied the 10.8 percent to the total food input to the household level. The calculation of the amount of food entering households has been described above. The calculation of household losses follows:

	Tons (000 omitted)
Household (consumer)	
Wholesale/retail available	264,700
Times distribution factor (.72)	
Equals input to households	190,584
Times loss rate (.108)	
Equals consumer loss	20,583

The same 10.8-percent loss rate was applied to the value of food entering households which assumed a one-to-one relationship between quantity and value loss. In the Tuscon case this resulted in a more conservative estimate of loss than that obtained by extrapolating the Tuscon estimate of dollar loss.

ASSUMPTIONS USED IN CALCULATIONS

Several general assumptions made in estimating losses follow.

--Loss rates established for a commodity in one geographic area were assumed to be representative of all areas.

--Adjustments were not possible to reflect use of losses for animal feed or industrial purposes, but the text discusses the extent of knowledge, which is limited, on these subsidiary uses.

--Human food use was considered the highest and most valuable use of a product. Grades and other quality/potential, quality-limiting factors were not considered to render products inedible or otherwise unfit for human consumption.

APPENDIX III

AGRICULTURAL RESEARCH SERVICE

OFFICE OF ADMINISTRATOR

OF UNITED STATES DEPARTMENT OF AGRICULTURE

WASHINGTON, D.C. 20250

JUL 13 1977

Mr. Henry Eschwege
Director, Community and
Economic Development Division
United States General Accounting Office
Washington, D. C. 20548

Dear Mr. Eschwege:

As requested in your letter of May 24, attached are the Department's comments on your draft report to the Congress on food loss in the United States.

Please advise if we can be of further assistance.

Sincerely,

T. W. Edminster
Administrator

General Comments on GAO Manuscript, "Food Waste: An Opportunity to Improve Resource Use"

This report calls attention to an area that obviously is important and merits more attention in the context of today's problems. However, this manuscript as presently written would get the attention of the press, but it would give the public a false impression about the costs of waste and the benefits of waste reduction.

Estimates of waste, both quantity and value, are based upon very limited information. GAO's recognition of an inadequate data base on food waste is commendable (Ch. 2). Likewise, its recommendation that USDA "...undertake a comprehensive study of both the magnitude and causes of loss" (p. i) is justifiable, and the discussion on the economic considerations in food losses on pages 64-66 appears to be on target. Having made these points, it then would seem appropriate to hold in abeyance all other inferences and recommendations, especially until completion of the recommended study of the situation. But the report continues as if the estimated magnitudes and causes of the losses were reliable. The reported estimates and estimation procedures encompass issues relating to both physical and economic measurement. In addition, in recommending an increase in the level of USDA research devoted to loss reduction, there were no specific guidelines presented for changing the thrusts of ongoing research, nor any consideration of competing uses of research funds including other ways of increasing the available supply of food. Some discussion of these and closely related issues follow:

1. Calculation of losses (Ch. 3 and Appendix II). GAO estimated that 20 percent of all food produced (including animal feedstuffs) and 23 percent of food produced for direct human consumption (excluding animal feedstuffs) were lost in 1974. The 20 percent number corresponds with an estimated 140 million tons of food valued at $31 billion.

[See GAO note 1, p. 73.]

   a. The estimated physical amounts of food loss take into account quantity only. It is implicitly assumed that application of future research solutions to the loss problems would, at the same time, bring the "saved food" up to a standard quality (if lower quality contributed to the loss). This does not seem to be a reasonable assumption.

   b. A related but more serious problem in the GAO estimates of the dimensions of the food loss problem relates to the $31 billion value of the loss. Without appropriate qualifications, readers will interpret this figure to be the actual potential value of the results of the recommended increased research. One major qualification would be some

appropriate discount for the lower quality of food lost than that consumed. Another qualification should be an assumed rate of reduction in the loss over time consistent with expansion in domestic and foreign demands beyond the normal increases in production in order not to depress market prices with the increased supplies. Otherwise, we could get into a problem with inelastic demands (price and income) and with possible substantial increases in public costs of farm commodity programs either to store excess production and/or to subsidize exports of those commodities in surplus.

c. Still another qualification applicable to the $31 billion figure is a practical limit on the reduction in losses (given the prices used to figure the $31 billion) through new technology or improved production, managerial and consumer practices and behavior. It is possible that a reasonable estimate of the practical limit in this reduction of losses per year might be very small, which could be interpreted to mean that the magnitude of the total problem is not $31 billion (or some substantial but lower number) but rather some relatively insignificant amount. The recommended comprehensive study by USDA, if done, should focus upon such matters.

2. Recommended expansion in research. The deflation of the $31 billion in losses through economic and quality considerations would lower the potential value of research to reduce these losses. The probability of success of the research also would need consideration when deciding upon any specific expansion to reduce the losses. However, what's more important is that research for the purpose of reducing food losses must compete with research to increase food supplies (if needed) by other means, such as increasing crop yields. GAO says ARS research devoted to reducing food losses amounted to less than 5% of the total research outlays. When considering potential returns from alternative research projects, that allocation to food losses could be near optimal. At least GAO has neither presented the data, nor an appropriate rationale, to support a shift of scarce research resources to projects on reducing food losses.

[See GAO note 2, p. 73.]

3. Food Stamp Program. There is concern about the way the subject report presents the 5 percent "waste" factor in establishing food stamp benefit levels, and the conclusion that this represents a $259 million loss of food and dollar resources. This might suggest to some that the food stamp allotment should not contain a "waste" factor. It is impossible, however, for any consumer to exactly match the varying nutritional and caloric needs of household members with the amount of food purchased and prepared, especially

[See GAO note 3, p. 73.]

since food is not sold in the exact portion sizes needed to maintain health. Without a "waste" factor, recipients would not receive nutritionally adequate diets. Also, since the report concedes that 5 percent is an arbitrary number, the stated dollar value of the loss, $259 million, is arbitrary as well.

[See GAO note 4, p. 73.]

The report recommends that USDA issue consumer publications which focus primarily on minimizing food loss through proper storage and handling. Although USDA publications already include information on maximum storage times, such information also contains a "margin of safety" so that consumers encounter minimum risk in using their food. (Thus, some food which is safe to eat might be discarded to assure that unsafe food is not eaten). USDA publications should continue to focus on safety first and minimizing food loss second.

[See GAO note 5, pp. 73 and 74.]

The report contains findings from the Tucson study, "Le Project du Garbage" indicating that Tucson households waste 9.5 tons of food annually, or 4.5 percent of the estimated household food wastage in the country. However, Tucson's population is only .14 percent of the U.S. population. Since there is no reason to believe that Tucson's residents "waste" a disproportionate amount of food, these statistics are highly questionable and cast doubt on the overall validity of the methodology used. As an aside, although it may be suggested that a study similar to the Tucson study be used to measure the effectiveness of food stamp recipients' diets, we do not recommend it. There is no reason to believe that the Tucson study is representative or that it is a better way to evaluate food stamp recipients' diets than the ARS Food Consumption Survey currently in progress.

4. Child nutrition programs and Nutrition and Technical Services staff. Digest, page ii of the report states, "Both the Department of Agriculture and the Congress recognize plate waste to be a problem in the National School Lunch Program." The NSLP is the only institutional food service program noted as having plate waste. Additional references might add that this is also true for feeding operations on military bases, in hospitals, residential institutions, etc.

Page 2, paragraph 1: In regard to the stated omission of losses of seafood and imports, it should be noted that the National School Lunch Program food consumption values have included these items whenever they were served in sample schools.

[See GAO note 6, p. 74.]

The estimated plate waste dollar value ($576 million) is overstated for three reasons:

(a) Page 40: It has been erroneously assumed that the entire $3 billion Federal obligation is spent on food. In fact, only approximately 55 percent of the Federal expenditure

is for food. The remaining 45 percent is spent for administrative expense, labor, equipment, utilities and other nonfood costs.

(b) Page 28: The USDA study cited is inadequately reported. While initial values indicated 19.2 percent of the National School Lunch Program plate waste, the report goes on to state, "The above figures are based on a sample including four-fifths elementary schools, which studies show have a consumption rate about 10 percent lower than that found at the secondary level. Nationally, elementary schools comprise about 55 percent of the schools in the lunch programs. Weighing these factors in assessing the data at this stage of analysis, suggest that the most likely overall estimate on how much of the school lunch is consumed is 85 percent." Accordingly, the more correct figure to use for average NSLP plate waste is 15 percent, not 19.2 percent. This should also affect values reported on pages 28, 40, 87, and 88.

[See GAO note 6, p. 74.]

(c) Page 40: "...assuming a one-to-one relationship between quality and value loss to estimate dollar loss...": This is an invalid assumption. As the data cited at the top of page 28 clearly shows, the more costly food items, meat and milk, are consumed at a greater rate than the less costly costly fruits and vegetables. This fact precludes the simple calculation of a dollar amount of plate waste from the information given.

(d) Page 38: "...determining the nutritional standards needed... and, if found desirable, revising the program's meal regulations..." The Department recently completed a review of the National School Lunch Program meal patterns in conjunction with new knowledge about nutritional needs, food consumption habits and children's food preferences. This review has led to recommended meal pattern revisions which are about to be proposed for general rulemaking. We anticipate that the revisions could decrease plate waste.

5. Food Distribution Program. In its Audit Report CED 77-32, GAO stated that the surplus removal and price support programs which were established with the intent of avoiding waste by using surplus foods go a long way toward meeting local school districts' needs. FNS generally agreed with the findings in that report, and the Department has already implemented several of the recommendations. The shipping periods for many foods are extended to coincide with local school district needs. Schools are no longer required to accept foods they cannot use nor in amounts that cause huge inventories and possible waste. The school districts' views on the types and amounts of foods needed are being solicited and will be given strong consideration before purchasing. Furthermore, States will be immediately notified of pending purchases and expected shipping dates.

APPENDIX III

Summary. This report attempts to bring into focus information on an important issue that can be highly useful to decisionmakers. However, the body of knowledge concerning food waste is quite limited to say the least. Quantification of food losses in the report greatly exceeds the data limitations and fails to give adequate consideration to technical and economic factors. Therefore, the report should have major revision to prevent misleading policymakers and the public.

GAO notes:

1. The estimate of 140 million tons has been revised to 137 million tons based on more recent data provided in the Department of Agriculture comments. This reduces the proportion of food produced for direct human consumption that is lost to 21 percent. The proportion of all food produced that is lost does not change because the decline is too small to affect the rounded percentage. The value of food lost does not change because a more conservative figure was used to estimate the value of institutional loss, which is the figure that was revised. (See p. 64.)

2. The final report has been revised to recommend that the priority given loss research be reviewed.

3. The estimate of food stamp loss has been revised on the basis of more recent Agriculture estimates of fiscal year 1977 food stamp obligations.

4. This comment is not correct. The report discusses Agriculture publications but makes no recommendations with respect to them. (See pp. 37, 49, and 50.)

5. Agriculture is questioning the validity of the Tucson data. The 4.5 percent figure computed by Agriculture is based on a 9.5 tons per household figure. That figure should have been 9,500 tons loss for all of Tucson's households. Using the Agriculture methodology, Tucson loss now computes to .045 percent of all U.S. households loss. This would indicate that Tucson's households waste less than its proportion of U.S. households (not population as Agriculture's comments state). There are, however, several difficulties with this type of comparison. First, as the report states, (p. 8) the geographic representativeness of Tucson is not known. According to the Tucson study, Tucson has 27 percent Mexican Americans who waste considerably less food than other households, while using more food per household due to large family size. Second, a comparison with our household loss estimate should not be made because of the lack of certain loss data at earlier points in the food system. A certain amount of loss unavoidably attributed to households actually occurs farther upstream. This affects only quantity of household loss--not total quantity or any dollar value. Despite these difficulties we decided to use the Tucson data because it (1) is the only study of household loss we could identify as having been done in more than a decade and (2) offers a minimum, and hence conservative, loss figure in that it measures food waste

actually going out in the garbage and so avoids some of the biases of the earlier studies. (See pp. 7 and 8.) [To avoid confusing the reader, we have not referred to the 9.5 ton figure.] In addition, the researcher in Tucson pointed out that the 9,500 tons do not include food disposed of through garbage disposals but that the 10.8 percent waste figure does include a garbage disposal factor. The 9,500 ton figure therefore understates Tucson garbage losses.

6. The estimate has been revised on the basis of the more recent data provided in Agriculture's comments. (See p. 28.)

PRINCIPAL OFFICIALS RESPONSIBLE FOR ADMINISTRATION OF ACTIVITIES DISCUSSED IN THIS REPORT

	Tenure of office	
	From	To
DEPARTMENT OF AGRICULTURE		
SECRETARY OF AGRICULTURE:		
Robert Bergland	Jan. 1977	Present
John A. Knebel (acting)	Oct. 1976	Jan. 1977
Earl L. Butz	Dec. 1971	Oct. 1976
Clifford M. Hardin	Jan. 1969	Nov. 1971

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