ECONOMIC CONSIDERATION IN THE ADOPTION AND
DIFFUSION OF FOOD LOSS REDUCTION INNOVATIONS IN
THE MARKETING PROCESSES IN DEVELOPING COUNTRIES

By

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To Monica and little Yito

To my parents

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TABLE OF CONTENTS

iii

TABLE OF CONTENTS (Cont'd. . .)

I. INTRODUCTION

The General Problem

It is universally recognized that there is a need for increasing the amount of food available for human consumption, and at the same time, for improving the mechanisms of distribution, with views towards making it possible for people to gain access to that food. Some people have manifested doubts about the possibility of adequately feeding the total human population, given the present trend in population growth and the state of the arts. Others, the majority, believe that solutions exist but, however, readjustments in the traditional programs are required. The previous attitude of confidence about the feasibility of achieving targeted goals in population growth and food production, once the implementation of well-known solutions were possible, has changed to one of greater awareness about the complexity of both problems.

Reducing the loss of food that occurs from harvest until its consumption has become one of the strategic points towards which the efforts of a great many national and international institutions have been directed. Thus, the emphasis of some years ago in increasing production has been coupled with attempts to make sure that food is accessible to a larger mass of consumers. In this perspective, the reduction

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in food losses might be seen as having a double impact. By
minimizing losses, a greater amount of food would be
immediately available and, at the same time, as costs and
prices of food are likely to be reduced, the effective
demand might be raised. Food loss reduction would, then,
help to close the gap between potential and actual demand for
food.

Paralelling the interest for reducing food losses, an
interest in improving the performance of agricultural market-
ing systems has developed. This does not mean that the need
for reducing food losses has been the sole driving force for
improvements. The understanding of the multiple interrelation-
ships among the different subsectors in the economy has played
an important role in it. It has been sufficiently documented
that the level of performance in each subsector is likely to
have an effect which spreads throughout the entire economy.
Therefore, food losses being just one of the multiple dimen-
sions of performance in the marketing system, we cannot expect
to have a substantial impact in their reduction if we overlook
the comprehensive nature of the problem. The adoption of
improved technologies and managerial practices in the produc-
tion-distribution-consumption process seems to be a condition
necessary, but not sufficient for success in food waste
reduction programs. Shifts in other dimensions of performance
and actions taken in other subsystems of the economy may have
a great bearing in the final outcome of those programs.

Studies and programs carried out with an aim at reducing food losses have had various focuses. Most have concentrated on a single product or group of products, or in a particular country, or on a specific stage between production and consumption, or on a specific causal agent of loss. Few have tried to be more comprehensive. However, a common characteristic is a consistent bias against the microeconomic considerations in the analysis of the adoption of technical-managerial innovations in the marketing process. They are sometimes mentioned but not explicitly treated. The usual cost-benefit analysis deals with aggregate variables such as consumption, employment, income distribution or input reduction, skipping the analysis at the firm level. Schermerhorn who discusses specifically the cost and revenue considerations in the reduction of food losses, is one exception.[1]

A premise in this paper is that without exception any technique or practice adopted with the intention of reducing or eliminating food losses will have an associated cost. For a firm to adopt the innovation, it has to yield a certain level of profits, at least in the long run. A firm, and even a whole industry, can operate with revenue below costs during a certain period of time if they perceive a profit in the

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[1]Richard W. Schermerhorn, Economic Issues Associated with Food Loss, A.E. Extension Series 203 (Moscow, Idaho: University of Idaho, 1976).

future, which more than offsets the temporary losses.

Moreover, the idea is submitted that programs failing to consider the microeconomic dimensions in the process of adoption of innovations are apt to fall short in meeting the expectations. They will be risking, at best, disruption of the traditional production-distribution mechanisms without generating the conditions for improvements in the marketing performance and reduction in food losses.

Objectives

Having in mind the general problem and the postulates stated above, the objectives of this paper are as follows:

- To present the food problem and to discuss the food loss question and its role in the food problem.

- To sketch a conceptual framework for the analysis of cost and revenue considerations in the design and implementation of food loss reduction programs.

- To outline some basic aspects in the economics of the adoption of food loss reduction innovations under different contexts.

- To analyze the practicability and institutional options for the implementation of the concepts previously discussed.

The remainder of the paper has been organized following the same sequence in which the objectives were presented. Chapter II deals with the first two objectives; Chapter III is devoted to develop the conceptual framework referred in the third objective; Chapters IV and V are dedicated to the analysis of the aspects indicated in the last two objectives,

respectively.   A brief chapter of concluding remarks is in-
cluded at the end of the paper.

II. THE PROVISION AND REQUIREMENT OF
FOOD IN DEVELOPING COUNTRIES

This chapter offers a description of the so-called food and food loss problems. The description of these phenomena and the analysis of the relationship between the two is important in the understanding of the magnitude and complexity of the topic we are dealing with. At the same time, it allows us to locate the subject of the paper, economic considerations in the adoption and diffusion of food loss reduction innovations, in the general context generated by both problems.

The Food Problem

Thomas Malthus never dreamed that his name and ideas would endure and be quoted so often, some 200 years after they were proposed for the first time. The idea of a population growing by geometric increments while food supply was growing only by an arithmetic ratio, with a result of hunger and starvation, involves such simple mathematics that shortly thereafter it was overruled by unforseen facts. As recent as the late 1960's we still were told that Malthus' proposition had been defeated by the great adaptability of man, who through his mastering of science had given a new formulation to the food-population equation. Those were the years of the

amazing increase in agricultural productivity and production in the developed world. Many hopes were deposited in the new varieties of wheat and rice and in the low fertilizer prices. In other words, the so much promising "green revolution" for the less developed countries. That was also the time when birth control techniques made it look like curbing population growth would be a sure development. With all these factors in mind, it is just understandable that optimism flourished and the validity of "Malthusian forces" in many areas of the underdeveloped world were overlooked.

This paper is not an attempt to prove Malthus' idea true. In fact, I believe that the historic determinism implicit in the Malthusian proposition, hunger as an inescapable and natural destiny of mankind, is its real weakness rather than its inaccuracy in the prediction of pattern of population and food growths. The question at this point is not whether the world has the ability and capability to feed its people, but how to accomplish that.

Localized famines and generalized malnourishment present in many developing countries are problems likely to effect all countries, developing and developed alike. In the long run, stability and pacific coexistence require that solutions be found in a global context, probably involving a new world order. However, the most crucial aspects in the short and medium run solutions are country-specific or, sometimes, region-specific, so that the initiatives undertaken

should be tailored to the particular characteristics and requirements of each location.

The World Food Conference has projected a total demand for cereals of 929 million tons by 1985, in the developing countries. At the same time, projections of production in the area only amount to 853 million tons, assuming the past trends continue. Important deficits in grain legumes, starchy roots and tubers, oilseeds, fruits and vegetables, are expected as well.

Both national and international institutions have engaged in the difficult task of increasing the food availability. Their efforts have been mainly channeled toward increasing acreage and productivity, and multiple cropping systems. However, due to the search for soundness in food policies, studies about food distribution systems and market-related policies have been acquiring more and more relevance lately. The realization that effective marketing systems have a strategic role to play in the alleviation of the food problem, however, has not been a painless process. As Harrison points out in a study about the improvement of food marketing systems in developing counties, "in fact, our evidence suggests that at some stage public agency efforts to stimulate the development of effective internal markets may become crucial to development" but "many development strategists are not convinced that the above arguments are valid." Furthermore, he adds "there has been little recognition of the

possibility of treating marketing intermediary firms as providers of socially useful services for whom positive policies should be developed to encourage and induce social performance and productivity."[2] This quotation is intended to serve as an introduction to the subject of this paper. It suggests the kind of linkages existing between the efforts related to the reduction of food losses, one of the parameters by which the system performance is measured, and the improvements in food marketing. At the same time and by extension, it alludes to the linkages between the improvements in the marketing systems and the overall efforts to solve the food problem.

The Food Loss Problem

In the last years a new focus of attention has developed, the reduction of food wastes and losses. The sometimes called "neglected dimension" of the food problem, or the "hidden harvest", has been the subject of a resolution by the Seventh Special Session of the U.N. General Assembly, which in September, 1975 set the target of a 50% reduction in post-harvest food losses by 1985. The potential impact of the measure may be assessed by looking over the magnitude of the

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[2]Kelly Harrison et al., Improving Food Marketing Systems in Developing Countries; Experience from Latin America, Research Report No.6 (East Lansing, Michigan; Michigan State University, 1974), p.3.

losses. According to FAO, mechanical losses in developing
countries, from harvesting to processing, are in the range
of 5-10 percent. Losses due to physical causes of roots
and tubers in storage average 10-20 percent after three
months. Physical damage of fruits and vegetables during
transport are responsible for losses of the order of 10 per-
cent and may reach 30 percent. Biological causes are cited
as contributing to a loss of 10-20 percent of actual yield.
The same source indicates that small farmers usually avoid
losses by growing only the amount required by them and their
families but marketed products may suffer up to 50 percent of
actual yield.[3] Allowing for some inaccuracies in the esti-
mates, the percentages are still impressive and they do not
leave doubts about the importance of food losses in the un-
balance between food requirement and availability.[4]

Food losses may be broadly defined as a loss in the
availability, edibility, wholesomeness, or any other charac-
teristic that keeps a certain food material from reaching its
destination, the final consumer, and being used for feeding
purposes. There exist two general types of losses, physical
and economic.

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[3]Food and Agriculture Organization of the United Nations,
"Prevention of Food Losses," Report C77/19 (Rome: August,1977) ,p.3.

[4]These percentages are referred to loss of product but
not to economic losses. They give an idea about the magnitude of
the physical losses but say very little of the amount of food
that is feasible of being saved from wasting. Technical and cost
considerations will be actually setting the limits to the food
loss reduction possibilities.

The first category encompasses the reduction in quantities of food disposable for consumption and the loss of quality (edibility and wholesomeness) due to biological, mechanical, chemical, physiological or other causes. These are the type of losses usually referred to as food losses since they are the most visible. However, certain losses in quality, the loss in nutritional value, for instance, are sometimes very difficult to notice and/or measure.

The second category, economic losses, may be seen as the financial impact of losses in quantity or quality occurring in the flow of products. Economic losses can be analyzed from the point of view of each participant in the marketing channel, as representing lower returns to producers, higher costs and therefore higher margins in the distribution process and, lastly, higher prices paid by the final consumers. In addition, food losses have a wider economic impact if the concept of opportunity cost is introduced into the analysis. The resources and efforts spent by producers in the production of the lost output could have been allocated to other activities. The financial capabilities and energy compromised in absorbing the losses could have meant otherwise a greater output delivered at the same cost or the same output at a lower cost. For the final consumer lower prices and therefore, higher real income, could have signified an increased and improved food consumption, and probably some money diverted to other non-food expenditures.

Loss of food is likely to occur at any point between production and final consumption but most studies refer losses specifically to a certain stage, for example, pre-harvest and post-harvest (including harvesting) losses are commonly studied. One reason for this classification is the traditional view of production and distribution as processes completely separated. This view is usually incorporated to specific programs which, in turn, are the responsibility of different institutions or divisions within an institution.

There are some methods of control with purposes of reducing food losses which are quite production-specific, such as weed control. However, by adopting a "system orientation", which views distribution as an integral part of a continuum from production to consumption, we come to recognize that decisions taken by the farm operator are very much influenced by market considerations. And these decisions in turn will have a later effect in the distribution and consumption processes. We may think, for instance, of a farmer deciding not to apply the recommended amount of fertilizer to a given crop due to cost considerations. This is likely to produce an internal nutritional unbalance in the crop and be the cause of physiological reactions taking place later during storage. The final result will be a sequel of physical and economic losses spreading down into the marketing channel.

In this paper the emphasis will be put on the deci-
sion making and activities performed by the marketing
intermediary firms. Thus, for practical reasons, when
talking about food losses, the topic will be usually paralell-
ing the so-called post-harvest losses. Efforts will be
made not to lose sight of the previous considerations. By
the same token, food losses occurring at the consumer
level will not be specifically mentioned.

Reduction of Losses: A Review of Approaches

Regarding the means to reduce food losses, there
exists a wide variety of approaches. Bourne emphasizes the
fact that many techniques for preserving food are available
but they are not all suitable to be applied in all circum-
stances, regardless of particular customs and financial
capabilities.[5] He points out that besides the obvious need
for more and better storage, handling facilities, means of
transportation and education at all levels, the development
of country-specific technologies is the crucial point in the
transference and adaptation of technology in developing
countries. There are some methods for preserving food such

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[5]Malcolm C. Bourne, Post Harvest Food Losses - The
Neglected Dimension in Increasing the World Food Supply,
Cornell International Agriculture Mimeograph 53 (Ithaca, New
York: Cornell University, 1977).

as freezing, freeze-drying, sterile filtration and irradiation, among others, which can have an application only in developed countries, due to their high costs. However, there are some other techniques, e.g., drying, refrigeration and cooling, use of chemicals, fermentations, canning, packaging and protective storage, widely known at the present and with great possibilities of playing a more significant role in developing countries.

Spurgeon characterizes the past attempts to transfer ill-suited technologies from developed to developing countries as having excessive preoccupation with a single component of the total problem, insufficient awareness of traditional and prevailing technical, environmental, economic, and social conditions, in summary, a piece-meal approach.[6] He also points out the skewed solutions (e.g., heavy emphasis in only one aspect, storage). He proposes that in order to cut down on post-harvest food losses a system approach should be adopted. Spurgeon sees this approach as a means for adjusting the various elements that make up the system, creating the conditions for improved performance.

FAO activities in food loss prevention encompass various cooperative efforts with multilateral and bilateral agencies but their strategy for the reduction of post-harvest

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[6]David Spurgeon, Hidden Harvest. A Systems Approach to Postharvest Technology (Ottawa, Canada: International Development Research Centre, 1976).

food losses in developing countries is primarily centered in the development of national programs.[7] In the formulation of these programs, the target of a 50 percent reduction of post-harvest food losses by 1985, adopted by the UN General Assembly, has had a great weight. Priorities and areas of action have been selected trying to achieve a greater impact. First priority is the reduction of losses of foodgrains, roots, and tubers. Countries most severely affected by the food problem and within those, the rural sector, also constitute priorities. Basically the programs proposed by FAO are made up by elements such as loss assessment surveys, drying, on and off-farm storage, pest control, processing, technical assistance and training. Some selected projects related to the mentioned elements have been designed as starting points or models, in order "to act as springboard for development, to generate further action to improve the income of the small farmer."

A different approach is the one chosen by Greeley.[8] He uses a social cost-benefit analysis in the evaluation of food loss reduction programs and emphasizes the effects and

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[7]Food and Agriculture Organization of the United Nations, "Prevention of Food Losses", op. cit.

[8]Martin Greeley. "Economic Evaluation of Programs to Reduce Post-Harvest Food Losses" (unpublished paper, Institute of Development Studies, University of Sussex, England, 1977).

priorities with respect to employment, distribution and balance of payment. Greeley points out the need for concentrating resources on the rural non-market segment and discusses the benefits accruing from a greater emphasis on labor intensive, local skill, and raw material intensive investment programs.[9]

Schermerhorn analyzes the food loss reduction problem from the individual firm standpoint, structuring his arguments around the profit concept.[10] According to this author, the economics behind food losses is the most important factor influencing the decision-making process at the firm level. Therefore, the movements in costs and revenues should be properly accounted for in any attempt to promote the adoption of managerial or technical procedures for the reduction of such losses.

If these are some of the most characteristic approaches to the analysis and design of food loss reduction programs, they only represent a small percentage of the studies carried out in the field of food losses. In fact, the

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[9]Greeley distinguishes the following subsectors within the post-harvest sector: (1) subsistance producers to rural consumers (rural non-market), (2) market producers to rural consumers, (3) market producers to urban consumers, (4) market producers to export, and (5) imports to urban/rural consumers.

The rural non-market subsector is characterized by on-farm operations of basically staple food, very low level of capital input and labor and services regularly paid in kind. The rural consumers are the producers themselves.

[10]Richard W. Schermerhorn. Economic Issues Associated with Food Loss, op. cit.

traditional emphasis has been placed in the study of
causal agents of losses and principally, in the methodologi-
cal aspects of food loss assessment surveys. Da Silva
made an extensive review of the literature and found that
most of the early studies were primarily concerned with
on-farm storage and with the control of biological agents,
such as insects and rodents, causing losses in stored crops.[11]
Although the same emphasis can be tracked in recent studies,
an interest for including other categories of food stuff
is arising. Da Silva suggests that the over-emphasis given
to the study of procedures for the assessment of grain
losses ,and the overlapping observed in the action of
several institutions, is inefficient and harmful since
this over-commitment precludes the allocation of resources
to the solution of alternative and important dimensions of
the problem. He concludes that sufficient methodological
bases in that area already exist and presents a procedure
in his view appropriate to be applied in developing countries.

Remarks

The food problem is of great magnitude. The size of
current and predicted shortages of food in developing coun-
tries is forcing the seeking for means other than expansion

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[11]Carlos A. daSilva, A Methodological Basis for the
Evaluation of Marketing Losses of Food in Developing Countries,
plan B paper, Department of Agricultural Economics (East
Lansing, Michigan: Michigan State University, 1979).

in production in order to control its impact. Reduction of food losses has become more and more important and is the focus of attention of many national and international programs at the present.

The reduction of food losses has been approached in different ways by different authors. Some make emphasis in the types of function that should be improved. Others in the need for adequacy in techniques and programs to the developing characteristics. Only exceptionally the private evaluation of food loss reduction has been taken into explicit consideration. This last point is considered in this paper as a major limitation in any food loss reduction program.

Solutions to the food loss problem must be sought for within a context of overall improvements in the marketing systems. This basic idea was introduced in this chapter and will influence the analysis and considerations throughout the paper.

In the next chapter the theories and analytical categories which seem germane to the study of the economics behind the process of adoption of food loss reduction innovations are presented.

III.   CONCEPTUAL FRAMEWORK

The food loss problem is not peculiar to developing countries (though its economic and social impacts are greater there), and therefore, the basic theoretical tools and concepts applied in its analysis may be universal. But as always in the application of theoric analysis to concrete problems, qualifications are unavoidable. We have to have in mind in the case of developing countries that the food production and distribution systems function under very particular social, cultural and economic constraints and that standard of performance must be set in accordance with these. Besides, standards may even have a great deal of variation among developing countries. Few people think now that the low level of equilibrium imposed by the constraints cannot be broken, or that only very slow changes are possible. Without being extremely optimistic, an acceleration in the development process through strategic changes in structural and performance aspects is becoming a widely accepted proposition. Improvements in marketing structures and performance as a strategic trigger mechanism for development is part of that conception. In this perspective, the problem becomes one of understanding how to put the proper forces to work.

This chapter defines a framework for the analysis of adoption and diffusion of technical-managerial innovations, and by extension, of food loss reduction innovations. The analysis of the decision making process at the firm level under restrictive conditions (i.e., when the whole set of assumptions of the theory operates) is the starting point. Modifications to that process when the firm operates under less limiting and more dynamic conditions is the following step.

The Role of the Economic Theory

When analyzing the food marketing system, we have to face the fact that there are no specific economic theories of its own or methods uniquely tailored for its study. Consequently, we have to resort to theories provided by the body of general economics. However, given the limited scope of this paper and its specific purposes, the focus will be principally centered in the theory of the behavior of the firm.

Food loss reduction at the firm level has little impact from the society's point of view, unless it is part of a generalized attitude in a channel or commodity subsystem.[12] However, there is no contradiction in concentrating the

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[12] Of course this does not hold with monopoly and not exactly with oligopoly. In those circumstances the decisions of the firm do have an immediate and perceptible impact in the market.

interest in the behavior of the individual firm since for
most programs the final result will depend on decisions
taken at that level. Going further, there will not be
successful programs if the actions which have to be taken
at the firm level are not perceived as beneficial by its
operator, no matter how attractive they may look from the
standpoint of society.

In the present analysis, the interesting part of
the theory of the firm is the treatment of cost and revenue,
and the role of profit in shaping decisions. The present-
ation by Hirshleifer will be followed.[13]

The conventional formulation states that the aim
of the firm is to maximize profit, this last defined as the
difference between revenue and cost.

Very briefly, the determination of profit and the
optimum of the firm in perfect competition may be illus-
trated by the diagram presented below. The situation in the

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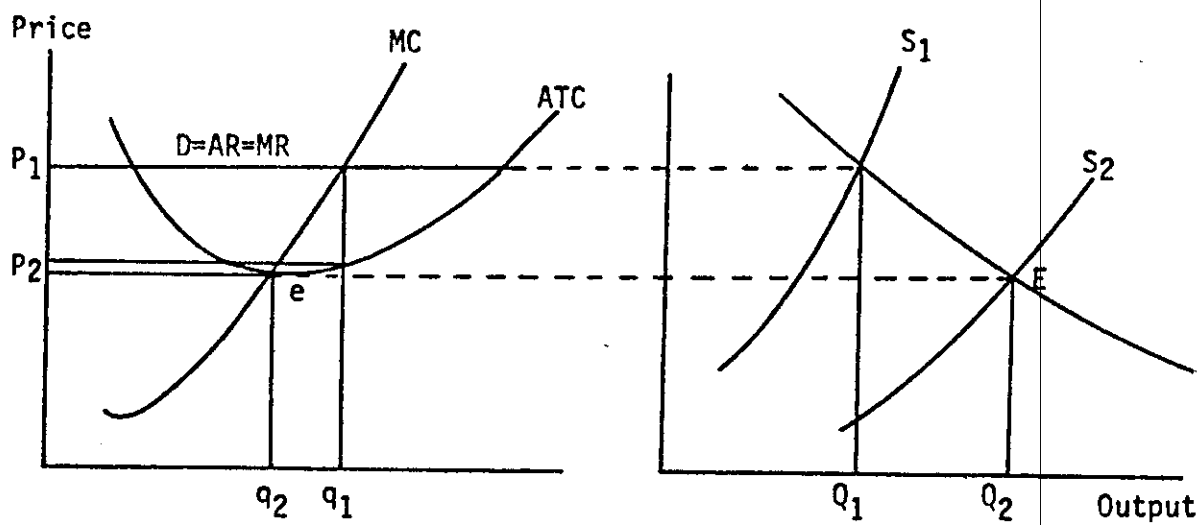
[13]Jack Hirshleifer, Price Theory and Applications
(Englewood Cliffs, N.J.: Prentice Hall, Inc., 1976), Chapter 9.

respective industry is shown at the righthand side.

A fundamental proposition of the theory is that profits are maximized at that output for which marginal cost (MC) equals marginal revenue (MR). In the shortrun for the perfectly competitive or "price taking" firm, the market equilibrium price is P_1 and the profit-maximizing output is q_1, the shaded rectangle representing profits (excess profits in this case). These profits act as an incentive for new firms to enter the industry, shifting the supply to the right and driving the market price down (P_2). After some adjustments, the long-run equilibrium is reached at the point where no profits exist for any individual firm in the industry.

No attempt will be made to illustrate the cases for monopoly, oligopoly or monopolistic competition since they do not add new insights. The important point to emphasize is that whichever the level of competitiveness, the profit-maximizing rule for the individual firm remains the same: to produce until the point in which MC = MR.

In addition to this fundamental principle, there are three other features in the theory which are important to observe because of their significance in the topic of this paper: (1) the time horizon of analysis, (2) the elasticities of the supply and demand curves, and (3) the "production" concept.

1. "In the short-run some costs are fixed; in the long-run they become variable" is the usual way in which the time span of analysis is characterized by the theory. It is easily noticed that the definition is centered in the limit on the input rather than the time period itself. This is an important element, since for the theory the production in the long-run is not subject to constraints on inputs. At that point an efficient equilibrium is reached by both the firm and the industry (and by extension by the society as a whole). As it will be seen later, for the individual operator long-run has a different connotation and this has necessarily a repercussion in his short-run decisions.

2. According to the theory, the supply curve for the firm is directly brought about from the input-output relationships, the production function, the firm is dealing with. And the demand curve is a result of the utility consumers derive from the possession and consumption of food and services. The aggregate curves for the industry or market are the simple horizontal summation of the individual curves.

Not all commodities yield the same level of utility or satisfaction to all consumers. On the other hand, firms have latitude to choose among a number of production processes and combinations of factors of production in order to reach a given output. This, along with the input and output price situations, will be given the elasticity or "responsiveness" of quantity demanded (or supplied) to changes in some causal

variable (such as the own price). The degree of reaction of effective variables to causal variables has a great bearing on the decisions of the firm. As long as revenues move in a different proportion than costs, the effects in the net cash flow of the firm may be used by managers in order to judge the correctness of their decisions.

3. The term production in economics is not restricted to the making of physical things but is also extended to any other process that introduces changes in a commodity, transforming it into a different one in an economic sense.[14] The new attributes are introduced by the action of various functions such as assembling, transportation, storage, wholesaling, grading, packaging, bulk breaking, retailing, and so forth. Such conceptualization of the measuring of production allows us to apply the same basic concepts to any commodity, whatever tangible or intangible.[15] And this has special importance in the cases of transportation and storage, functions which are often the center of attention in food loss reduction programs.

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[14]This process is known in economics as addition of space, time, form and possession utilities to commodities.

[15]However, we have to recognize that the treatment of intangibles has proved to be far more difficult than suggested by the theory.

A Second Best Approach to Imperfections in the Marketing Systems[16]

Neoclassical theory has the appeal of its preciseness to explain the behavior of the firm given a set of assumptions, specially in the polar cases of perfect competition and monopoly. Likewise, it presents a strong argument in favor of pure competition by stating that in this situation resources are employed at their maximum efficiency. However, any relaxation in the rigorous assumptions weaken this theory in such a way that many efforts have been directed to the development of new theories. These are in general, less precise but more apt to cope with the problem of analyses carried out in more realistic setting.

In fact, making a case for perfect competition the neoclassical theory only permits relaxation in the assumptions regarding the number of firms and homogeneity in the product, but fails to give equally precise instruments to deal with the impediments to the attainment of the other ideal conditions. In the real world the existence of imperfect competition, externalities and indivisibilities, as well

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[16]Second best is a term better defined in an ordinal way. The competitive model is by definition the most desirable economic organization, i.e., the first best. Whichever the reasons why the assumptions of the perfectly competitive model are not satisfied, the second best approach assumes that there is a proxy configuration, not as good, but the best attainable. This second choice may be close to or at least pointing to the direction of the competitive model, depending upon the real world constraints.

as the "irrational" behavior of the public (who may even be against efficiency in the classic terms), post such a burden on the theory that one is led to think that a freely operating price system will never produce an optimal allocation of resources and, therefore, optimality in this context ought not to be the aim for policy purposes.

It is worth noticing at this point, that the critics to this theory are usually positive rather than normative. The arguments have been mostly focused on the question of whether the model explains reality and not whether perfect competition is a desirable state. In general, the decision rule for optimization, the equalization of marginal cost to marginal revenue would continue to be relevant and the problem would amount to one of finding out to what extent it could be operationalized when other than first best conditions are present. However, the general nature of this assertion must be stressed. The location of the firm within an environment of dynamic uncertainty and the existence of conflicting goals and organizational complexities, are some of the factors considered in the profuse literature which makes a case against unqualified acceptance of the profit maximization assumption.

An important reservation to the rule springs from a Lipsey and Lancaster study often quoted in second best analysis.[17] They contend that if constraints within the system

[17]Lipsey, Richard G. and K. Lancaster. "The General Theory of Second Best", _Review of Economic Studies_, Vol. 24, No. 63 (1956-1957).

preclude a first best optimum, it will not be generally
desirable to strive for reaching that type of optimum else-
where in the system.

In spite of the reservations but to keep pricing
efficiency (MR = MC) as a basic guiding concept may be
justified in the following grounds:

(1) It is common for studies in food loss reduction
to emphasize the aspects related with technical efficiency,
somehow overlooking the economics. In other words, for any
set of inputs, given location and environmental constraints,
the question is asked of how the output of the system (food
in the hand of the consumers) can be increased. The assump-
tion is almost linearly that since more food available is a
desirable goal for the society, this has to be a private goal
as well. (2) For the firm there must exist an optimum, even
considering the distortions. This new (second best) optimum
is one that maximizes the benefit function given the con-
straints as they are generated in imperfect competition. In
such circumstances, the decisions at the firm level will not
create the conditions for equilibrium in the industry and in
the economy in the way predicted by the theory. But this is
no reason for thinking that the general principle for optimi-
zation will lose applicability in the restrictive micro-
environment of the firm. (3) Sometimes firms set prices
following criteria different from the marginal one (to match
competition, increase market share, only cover overhead
costs, get rid of unwanted inventories, etc.). However, they

will not be permanent decision making rules if financial deterioration of the firm is involved. This last aspect is yet more pertinent in developing countries where we usually will be dealing with rather small firms. Small firms have less latitude to set prices and hardly can afford to price below cost in other than emergency situations.

Trying to summarize these views it might be said that in a macro context the problem now is to find a new set of decision rules, other than first best, which given the new constraints maximize the aggregate value of output. Unfortunately, things are more complicated than implied by this simple statement. Going from first to second best the simple condition MC=MR has to be changed for extremely complex decision rules which, in general: (a) yield intricate and ambiguous directions for policy purposes, and (b) give no guidance to cope with a very realistic situation, this is, the absence of the information needed in the second best solutions.[18] On the other hand, for the individual firm the problem is simpler. Once the prices are set in the economy, following a second best or any other criteria, these become fixed from its point of view. In that case and as was mentioned in (2) above, the decision rules come to be operationally similar to those in a first best approximation.

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[18]Then, by pursuing a similar criterium of approximation by defect, we should try to go to third best solutions.

Having in mind their limitations, we can make use of some developments, which being second best type of approaches, have shown to be a helpful guide for comprehensive analysis of food marketing system in developing countries. Particularly, the theory of effective or workable competition. This theory develops the concept of "socially desirable" standards, which are not as rigorous as the neoclassicals but point to the same direction. Since food loss may be seen, and is in fact used, as an indicator of market performance, the generation of socially desirable standards of market performance may have a significant role in guiding empirical works in this field.

The theory of effective competition has its roots in the field of industrial organization. Scherer explains industrial organization analysis as the attempt "to determine how market processes direct the activities of producers in meeting consumer demands, how these processes may break down, and how they can be adjusted (i.e. through government intervention) to make actual performance conform more closely to the ideal."[19] In this perspective some people have tried to identify the variables affecting economic performance and develop theoretical explanations about the relationships between variables and the end adjustments. Important contributions have been done by Sosnick, whose scheme is used by Scherer to group the

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[19]Scherer, F.M. Industrial Market Structure and Economic Performance (Chicago, Rand McNally, 1970), p.2.

variables and end results in a model made up by three basic elements: a) structure, b) conduct and c) performance. Later he lists the norms and criteria to be fulfilled in each category if the industry or market is to be considered operating under effective competition.[20]

The theory of effective competition provides valuable guidelines for dealing in a practical way with problems concerning market performance improvements and allows for dynamic changes in competition. But, it lacks the preciseness of the mathematical formulations in the neoclassical theory and, therefore, is quantitatively less accurate. Moreover, its critics insist on the fact that a great deal of value judgements is involved in the determination of norms and criteria for workability and, in the definition and specification of the socially desirable goals to be achieved concerning performance.

System Approach to Marketing

System Analysis

The system orientation to marketing system studies used as a framework in this paper is drawn upon the conception developed by the Latin American Planning Center of Michigan State University. A marketing system is defined as "a primary mechanism for coordinating production, distribution

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[20]Ibid., pp. 4-6 and pp. 36-38.

and consumption activities."[21] This set of interrelated
and interdependent activities would encompass not only the
functions traditionally considered creating economic
utilities in the marketing process but also the institution-
al arrangements aimed at facilitating the operation of the
system. There are two important features in this approach:
(1) marketing is viewed as a system by itself, and (2) it is
also considered "a part of the set of activities coordinating
various stages in a production-distribution channel, such as
the food system or a commodity subsystem" (which, in turn,
can be considered a part of higher level and more complex sys-
tems). The synergism implicit in point (2) recognizes that
the quality of the performance in one subsystem set the
limits to the achievements in the others.

As mentioned earlier, the improvements in the market-
ing systems are a result of the adoption of innovative prac-
tices by managers of marketing firms in response to stimulus
provided by the economic, social and legal milieu. In this
paper changes introduced at the firm level will be associ-
ated with a process of adoption of innovation, while the same
process in a channel wide or system wide perspective will be
referred to as diffusion of innovation. It is precisely
going from one process to the other when the system approach
gives us its most helpful insights.

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[21]Harrison, Kelley, et al., op. cit., p. 4.

The experience in more developed countries suggests three chief sources of marketing performance gains: (1) economies of scale, (2) managerial-technological changes and (3) institutional innovations.[22] The first two are associated with what is referred to as internal and external coordinations, this is, either activities circumscribed to and dependent on the firm's decisions and actions, or activities not possible without the contact with other participants in the system. The third one has to do with actions taken almost exclusively outside the firm.

1. Economies of scale is the generic term for those factors that enable a firm or industry to have lower average costs by increasing the scale of operations. Lower costs do not stem merely from the intrinsic efficiencies embodied in the technology of large plants and equipment but from organizational efficiencies within the firm as well. Neither type of efficiency would be fully realized unless the external contacts of the firm are equally efficient.

2. Closely associated with economies of scale are the gains generated by managerial-technological innovations, although this does not signify that small scale operations necessarily spell inefficiency under all circumstances.

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[22]Harrison, Kelly et al. Fomenting Improvements in Food Marketing in Costa Rica, Research Report No.10 (East Lansing, Michigan: Michigan State University, 1976),pp. 13-16.

Again, the concept of internal and external coordination is important because of the synergism existent. According to Harrison et al., "in a progressive industry there is a continuous upward spiral of internally and externally oriented managerial-technological innovations" as "internal managerial-technological innovations in one firm may induce external managerial - technological innovations in many other firms."[23]

3. Institutional innovations are associated with changes in governmental policies and actions (monetary and fiscal policies, laws and regulations, provision of services) destined to create a favorable climate for the innovations in the firm or industry to take place.

Remarks

The expected profitability is a basic point for the adoption of an innovation by a single firm.

Neoclassical theory gives clear sets of decision rules for optimal adoption of innovations by firms and the diffusion of them throughout the respective industries. When the assumptions of the theory are not met the basic marginal criterion for optimization at the firm level continue to be valid. But now, there is no correspondence with an equilibrium in the industry and, therefore, with a general equilibrium in the economy.

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[23] Ibid., p. 15.

Second best approaches have been pursued in order to provide guidance to applied studies. These are less rigorous but seem to fit better the analytical requirements of applied studies about improving efficiency in marketing systems.

Finally, it has been suggested that marketing is not only a system by itself but has very defined (although not always very well understood) relationships with the other systems making up the economic organization. Hence, improving efficiency in marketing systems, and food loss reduction is one dimension of it, should be analyzed in that context.

Given this conceptual framework, Chapter IV will be dedicated to the examination of cost and revenue considerations in the process of adoption and diffusion of food loss reduction innovations.

IV. ECONOMIC CONSIDERATIONS IN THE ADOPTION AND DIFFUSION OF FOOD LOSS REDUCTION TECHNIQUES

The type of economic implications which this paper is most interested with are basically related to the changes in the components of costs and revenues prompted by the adoption of new, and hopefully improved, production techniques and managerial practices by firms performing marketing-related activities, in response to internal and external stimuli.

The analysis in this paper has been structured in a way such that the remarks are usually centered on the profit implications, deliberately isolating them from other non-economic aspects. By no means is it suggested that the impact on the balance sheet of the firm is solely responsible for the adoption of innovations. This focus was adopted to facilitate the analysis, and as a means of stressing one aspect of prime importance in the problem, sometimes feebly considered or simply bypassed in food loss reduction programs. When it is unavoidable to make references to other aspects in the adoption of innovation process, usually the province of sociology and psychology,[24] then, they will

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[24]Here we are talking about attitudes and beliefs, motives and perceptions, and how these categories shape the behavior of goal-oriented individuals.

be in general influenced by the summary presentation of such aspects made by Riley et al. in a report about food marketing in Puerto Rico.[25]

The division of the topic in the following three sections has expository purposes. It permits an organization of the discussion around some of the more salient aspects under each heading, although they are sometimes necessarily overlapping.

Cost and Revenue Considerations Under "Neoclassic" Conditions

Because of the rigorousness of its assumptions the neoclassical theory is rather conclusive in its treatment of the adoption of innovation process, especially in the extreme cases of perfect competition and monopoly. These views are static, equilibrium-seeking, and complete applicability is only possible as long as the basic assumptions are met. However, placing less stringent requisites to the analysis, the same general inferences can be extended to situations which are close to the "neoclassic" world in economics. Each departure from the theory will bring some associated loss in accuracy and room for controversy.

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[25]Riley, Harold et al. Food Marketing in the Economic Development of Puerto Rico, Research Report No. 4 (East Lansing, Michigan: Michigan State University, 1970), Chapters 1 and 7.

Traditional analysis assumes that firms operate only under efficient processes and that these are the only ones considered in decision making by a profit-maximizing firm manager. This does not mean that there is only one process to produce a certain output but several alternatives. Such diversity is the cause of the differences in the cost structure of each individual firm in short run equilibrium. However, efficient processes are part of the current and prevailing technology or "state of the arts", which by definition is known by, and available to each one of the firms in the industry. Therefore, in terms of the theory, innovations have to be considered in the context of a technological change.

It was mentioned in Chapter III that according to the neoclassical theory economic profits disappear in the long run equilibrium under competition. However, nothing keeps a firm from seeking for new processes or managerial procedures, allowing to it to do business in a more efficient way. When this happens, economic profits may appear again. But the innovational profits will be temporary since, in a new cycle of adjustment, all the other firms in the industry will end up imitating the new process. This is not the case under monopoly, where the firm is the industry and economic (monopoly) profits can persist over time. The implications of this phenomenon are not clear. We may think that firms in pure competition have an incentive for seeking and adopting innovations since this is the only way they can earn

supra-normal profits, which could be considered an argument in favor of competition. Contrarily, others might argue that the ease for matching innovations is likely to breed sluggishness rather than progressiveness. Similar types of arguments might be applied in the case of monopoly. Third positions favor situations lying in between. Unfortunately in this case indetermination persists since both the theory is less structured and the empirical studies have failed to show conclusive results. A more extensive discussion of this point is saved for the next section.

It would be naive to think about progressiveness as a consequence of some sort of pioneering feeling. For most firms innovation is a means to reach predefined goals, each of which finally has to be analyzed and decided in a financial context. The individual or private evaluation in the process of market modernization is a basic concept in the neoclassical theory and has been strongly emphasized by several authors. Schermerhorn insists in that "it is not enough to simply develop technology to eliminate loss -- the use of this technology must return to the user at least the cost of its use."[26] With this, we could infer that whichever is the degree of competitiveness in a market, if a technical-managerial innovation with views to minimize or eliminate food losses is to be adopted, the individual

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[26]Schermerhorn, Richard W. Economics Issues Associated with Food Loss, op. cit., p. 6.

operator has to perceive it as efficient (profitable), on the basis of the costs and returns associated with that decision. The decision to adopt an innovation, with its consequent changes in costs and revenues, can be seen as the passage from an old efficient condition to a new efficient condition, in both cases the efficient outputs being determined by the rule MR=MC. If the original financial position of the firm is shown in a cost/benefit ratio and this is compared with the new ratio, for the innovation to be adopted the following condition should hold:[27]

$$\frac{QO_1}{QI_1} \quad \frac{PO_o}{PI_1} \quad > \quad \frac{QO_o}{QI_o} \quad \frac{PO_o}{PI_1}$$

or correspondingly:

$$(QO_1)\ (PO_o)-(QI_1)(PI_1) > (QO_o)(PO_o)-(QI_o)(PI_o)$$

Where   QO is the quantity of output
        QI is the quantity of input factors
        PO is the output price
        PI is the input price
        the subscripts 1 and 0 stand for the with and without innovations situation, respectively.

The condition as presented assumes that the innovation has no effect on the output price. This will not hold in the case of monopoly or when the diffusion of the innovation

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[27]Adapted from an idea by R.M. Paiva in "Modernization and Technological Dualism in the Agriculture of Developing Countries: Some Normative Implications," Proceedings of the Seminar on Agricultural Policy: A Limiting Factor in the Development Process (Washington, D.C.: Inter-American Development Bank, 1975), pp. 151-154.

induces a change in output supply important enough to affect the price (long run equilibrium). A similar consideration could have been taken in the inputs but in that case we would not have included the quite reasonable alternative of using new inputs.

The formulation only considers single variables for quantities and prices, which is an extreme simplification indeed, especially as far as inputs are concerned. However, it is a useful expression since it illustrates the impact of two basic and related aspects in the success of an innovation: (1) it shows that if the productivity of the new factors increases with respect to the productivity of the old factors, the innovation will be relatively more attractive, and (2) it reflects the effect of relative changes of factor prices in the preference for innovation, e.g., if the price of capital increases more than proportionally to the increase in productivity associated with its use, a capital-using innovation loses advantages.

The conventional theory does not make a distinction between goods-producing and service-producing firms. In practice there are substantial differences. The one concerned with the characteristics of the demand for food and for marketing services induced by different levels of economic development is of chief importance in studies about food loss reducing innovations. Let's expand a partial aspect of the problem related to the elasticity of demand.

Most authors tend to consider reduction in food losses during the marketing process as a phenomenon whose benefits should spread throughout the system, reaching to each and all participants in it. Da Silva has summarized these views[28] and from it a simplified sequence of events might be thought up: assume that a process to reduce food losses is adopted by marketing firms in a given line of business due to purely financial considerations. This new, more efficient process, allows them to offer the same services at a lower cost or more services at the same cost, either one action resulting in smaller marketing margins. The reduction in margins brings with it both increase in producer prices and decrease in retail prices, which, in turn, induces increased production and consumption and new demand for marketing services. In sum, because of the innovation everybody will end up being better off. Unfortunately, the process never works so smoothly and a number of qualifications to this reasoning may be raised regarding for instance, the elasticities of supply and demand in the market of marketing services and in the goods market. Taking into account such qualifications, situations in which some participants in the marketing system become worse off after an innovation is adopted are perfectly possible.

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[28]Carlos A. Da Silva, op. cit.

When demand for a product does not increase in a proportion enough for neutralizing a price decline induced by increased supply (as it would in a food loss reduction program), the end result might be that the total revenue decreases at the producer level. Schermerhorn warns about this possibility and illustrates the point by giving a list of selected commodities, which, owing to their demand elasticities at the farm level, might present the mentioned effect.[29] The theory contemplates these movements in total revenue geared to the elasticity of demand by stating that (a) if the demand is elastic, a change in price will cause total revenue to change in the opposite direction; (b) if the demand is inelastic, the change will be in the same direction; and (c) the less interesting special case of unitary elasticity, event in which total revenue remains unchanged independently of the direction of the price change.

Elasticities of demand and their effects in the total revenue received by different market participants have interesting connotations from the point of view of introducing food loss reduction techniques in developing countries. In spite of the lack of information, empirical studies available permit some inferences. In general, we know that income elasticity of demand for food is relatively high, and particularly for staple commodities. This suggests that the price elasticities of demand should be relatively high

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[29] Richard W. Schermerhorn, op. cit., p. 13.

too.[30] Being this the case, a reduction in prices would bring an increase in demand such that the producers total revenue would increase at the same time. We should notice some policy implications in this fact. Because of the effect of substitutability among commodities, it would make a difference if the measures effect a single commodity or a group of them. Widening the boundaries of the category of food effected, the possibilities of substitution diminish and the demand becomes more inelastic.

Another point worthwhile noticing is that concerned with the differences in the demand elasticity for marketing services added to a product and that for the product itself. We know that marketing firms encounter different price elasticities affecting their transactions while products move through the marketing channels. But in general, we can say that the income elasticity of demand is higher for marketing services as compared with the elasticities of products themselves. Darrah discusses and documents this fact by presenting a list of price elasticities of demand for selected U.S. food products at the farm level, and the corresponding products at the retail level. The latter having invariably much higher elasticity values than the former.[31] While in developed countries this relationship

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[30]This follows from the application of the Slutsky-Shultz relation (or homogeneity condition) as presented by W.G. Tomek and K.L. Robinson in Agricultural Product Prices (Ithaca, N.Y.: Cornell University Press, 1977), p. 37.

[31]L.B. Darrah. Food Marketing (New York, N.Y.: The Ronald Press Co., 1971), p. 45.

will be always the case, in some developing countries, how-
ever, it might be reversed. In most developing countries
increasing incomes and urbanization process, among others,
are responsible for trends very similar to those in developed
countries as far as marketing is concerned. Yet in very
low income countries, for some products, for some type of
marketing services and/or in localized situations, this
might not be that true. To find out what is the "willingness
to pay" of potential customers for the cost associated with
services aimed at saving food from wasting has obvious
implications in the economics of food loss reduction programs.
And it will be a crucial point in deciding about the what's,
how's and where's of such programs.

Effect of Market Imperfections in the Analysis of Costs and Revenues

How different from theory are manager's views about
the possible movements in cost and revenue derived from his
own decisions and someone else's? How this could affect the
process of adoption of improved techniques in order to
reduce food loss? These are the types of questions which
lead us into a field of not easy answers or, at least, not
definitive ones. Some of the theoretical difficulties
were hinted in the previous chapter. In a more empirical
vein, however, there are some general conclusions that
could be drawn upon from the findings of some authors working
with the orientations of the industrial organizations approach

and the guidelines provided by the theory of effective competition.

The process of innovation or technological progress presents some definitional problems. It is easier to tell what the phenomenon looks like (i.e., the impact in productivity and in the quality of consumption) than to set the boundaries of it, that is to say, its starting point and when it is to be considered finished. Some may argue that innovation is a continuous process so that its boundaries cannot be defined. This assertion is of little value when we are trying to measure the costs of a given innovation, in order to compare them later with its benefits. Due to this difficulty most efforts have been directed to measure progressiveness rather than innovations themselves, using some indirect indicators. Resources spent in research and development (R&D) are assimilated to the concept of progressiveness. Next, the end results are measured by the growth in sales or other indicators of business performance. Obviously this is a partial remedy to the problem since it allows some inferences between the size of R&D outlays and growth, but cannot tell how much of that growth is directly attributable to a specific innovation.

Despite all the efforts up to now we are pretty much in darkness as to the measurement of efficiency in innovative work, that is, to accurately relate "inputs" and "output" and for that matter, link corresponding costs to

benefits. However, by avoiding some of the most controversial aspects of the issue, it is still possible to rescue some generalizations which are quite pertinent to the study of reduction in food losses. These have to do with risk and uncertainty, and degree of concentration.

Even accounting for the existence of what we could call innate disposition with respect to risk, in general, we will be always dealing with persons who have some degree of risk aversion. Risk aversion is a direct consequence of the presence of uncertainty in the decision making process. In these real-world conditions, the rational behavior will call for some sort of trade-off between what the operator perceives are the most likely average payoff and the variability of payoffs. Intimately related to this, further complicating the picture, we find the variability added by differences in the time horizon of analysis. And it is because of the element of uncertainty that a necessary difference between the concept of long run adjustment as conceived by the theory and as perceived by the manager of the firm must be made in empirical studies. In this point we are not only dealing with a problem of preference for present versus future returns, or the problem of choosing an appropriate rate of discount. The concern is also about the manager's willingness to take steps that could endanger his equity in a future conjuncture. The more important the proportion of the financial commitment with respect to the total equity of the firm,

the shorter the horizon of analysis is likely to be. The
same relationship can be formulated between time and risk
aversion, and between time and degree of uncertainty.

If innovation is not free of risk and then, of
costs, the immediate question is: Who are in better posi-
tion to bear the burden of it? The empirical evidence
seems to refute the idea that innovation would be a process
more dynamic in competitive industries. The fact of the
matter is not that competition inhibits innovation, but that
competition generally presupposes smaller firms than imper-
fect competition, and studies show that larger firms are the
more prone to put innovations in commercial practice. It is
a relative large size, by each industry or market's standards,
which gives the financial capability to bear the cost, and
specially the risk, involved in the process of adoption of
innovation. This is not an argument in favor of concentra-
tion. Although larger firms and concentration are commonly
correlated, the empirical testimony points out that when
moderate levels of concentration are reached sluggishness in
innovation appears again. Scherer presents qualitative and
quantitative evidence at this respect and advocates a situ-
ation with light monopoly power, in the form of structural
concentration, provided that certain conditions are met, e.g.,
low barriers to entry, in order to maintain the industry in
continuous threat by potential entrants.[32]

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[32]F.M. Scherer. Industrial Market Structure and
Economic Performance, op. cit., pp. 370-378.

Inasmuch as in developing countries the structural characteristics of the marketing systems, as well as their interactions with the other systems in the economy differ from that encountered in developed countries, we might ask to what extent the above mentioned generalizations apply to them. In developing countries an atomistic structure in the marketing systems and rather low, if any, barriers to entry are the most usual characteristics. But this competitive setting is not associated with innovative behavior, confirming similar findings in developed countries.

However, concentration is not a foreign phenomenon in developing countries and localized monopolies are not difficult to find. Particular importance have the spatial monopsonies or oligopsonies oftenly present in the rural stages of the assembly process. Interestingly enough, in these cases collusive actions have not been found to be of significance. If high marketing margins exist, Lele in Africa[33] and Harrison et al. in Latin America[34] have evidences to believe that they are a consequence of the uncertainties and overall inefficiencies in the markets rather than of collusive pricing behavior. Moreover, studies tend to show a

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[33]Uma Lele. The Design of Rural Development--Lessons from Africa (Baltimore, Md.: John Hopkins University Press, 1975).

[34]Kelly Harrison et al., Improving Food Marketing Systems in Developing Countries: Experience from Latin America, op. cit.

correlation, similar to developed countries, between progress-iveness and a firm size and, therefore, financial strength.

In developing countries the sociocultural conditions play a role of first order in shaping the views and actions of people with respect to innovation. There exists a profuse literature characterizing the average market participant as a very traditional person, hence, not inclined to innovate. Nevertheless, there is no reason to believe that the psychological factors have precedence over the economic ones. But they both interact, in the same way they do in any industrialized country. The predisposition toward changes can be mediated by the urge of meeting very basic needs and that can make anybody a very traditional person. When basic needs are satisfied the luxury of being more of a risk taker can be afforded and, in this circumstance, firm managers in developing countries are subject to the same type of considerations discussed at the beginning of this section. What makes the problem in developing countries many times more complex is the high cost of adoption of improved technical-managerial practices resulting from high levels of risk and uncertainty which, in turn, are a direct consequence of the poor coordination prevailing in the marketing systems.

This is not merely a theoretical discussion, but a very practical matter. It has been emphasized several times in this paper that the final decision regarding the

adoption of an innovation is made by the manager by con-
trasting the perceived costs and benefits. When the ratio
benefit to cost is estimated by an outsider (policy maker,
technician, etc.) the final figure is likely to be higher
than the one estimated by the firm operator. The differ-
ence being in who bears the risk of losing equity or, in
extreme cases, the very subsistence for him and his family.
The discrepancy is not meaningless. Many authors have
suggested that one way to attack the food loss problem in
developing countries is through the adoption of appropriate
technology developed in other counties (appropriate meaning
suitable to their conditions, i.e., high unemployment, lack
of access to capital, lack ow know-how and so forth). It has
also been suggested that there already exists many tech-
niques that could be easily introduced since they require
very little monetary investment. So that we are witness-
ing a surge of programs fostering the application of these
well-suited techniques. However, chances are that such
programs will fail to meet the expectations if their attrac-
tiveness from a private point of view continues to be
assessed by "objective" standards (objective as synonymous
of risk-free). The usual sensitivity analysis is inade-
quate to capture uncertainty in the way it is perceived by
the individual operator and maybe it would be worthwhile to
channel some effort toward conceptualizing and devising means
to measure what could be called the costs of transfer.

In terms of the formula given in the previous section:

$$\frac{C_1}{B_1} \geq \frac{Co + (CT)(Bo)}{B_o}$$

where C stands for costs, B stands for benefits, CT stands for costs of transfer, and the subscripts 0 and 1 stand for the situations pre and postinnovation, respectively.

Traditionally the phasing from the pre to the post-innovation situations is assumed to be instantaneous and cost-less and thus, the comparison of costs and benefits is a before and after type of analysis (or better, a with and without analysis, in the terminology of project analysis). However, there are costs incurred during the transition which, in fact, are neither part of what is considered the preinnovation situation nor part of the postinnovation situation. By not including such costs in the analysis we will be underestimating the real cost of the innovation. In this case the problem is eliminated if, being aware that these costs exist, we estimate and compute them. But the real complexity arises when we want to consider in the analysis the non-income costs and returns. The costs associated to risk and uncertainty (or looked from the returns side, the benefits associated with security), the costs of adopting a new organization of work (usually family work, in small enterprises), the benefits derived from change in status, and the like, are intangibles which do not lend themselves well to valuation. Because of this, the practice is to

acknowledge that they exist but without attempting to value them. Unfortunately in many cases (perhaps too many) the intangibles may be the decisive factor in the adoption of an innovation.

As presented the concept of cost of transfer may be difficult to grasp and even more difficult to measure. Maybe some help might be obtained from the field of sociology, where very sophisticated techniques are being used by researchers dealing with subjective perceptions. The important point to stress here is that despite the theoretical and practical difficulties the concept should be refined and applied in empirical works. For a food loss reduction technique to be adopted it is not enough that the cost-benefit ratio be higher with the innovation but it has to be much higher. The estimation of how much higher it has to be, i.e., the cost of transfer, becomes then of tremendous importance.

Economics of Innovation in a System-wide Perspective

Viewing a system as a set of elements, each element will have attributes of its own but also attributes which appear during its interactions with the rest of the system. That is why the mechanisms of innovation and of diffusion of innovation are not the same. It was stated before in this paper that the process of adoption of innovation is considered a phenomenon taking place within the boundaries of a single firm, while diffusion is necessarily an interfirm

process. In terms of the neoclassical theory the appropriability of an innovation by a single firm is temporary and as long as the new process yields a new efficient frontier (i.e., shifts the production function upward) the remaining firms in the industry will finally catch up in the course of a new cycle of adjustment. This sequence and straight determinism is hardly found in the real world. The optimum of the industry becomes extremely complex to determine when abandoning the nice grounds provided by the basic assumptions of the theory. All the qualifications to the theory in the case of a single firm discussed in the previous section apply now, several fold complicated by the diversity of firms within an industry. Management attitudes in the various firms can be ranked from intrinsically innovative to intrinsically laggard, and by intrinsic is meant that people may be prone to innovate but not necessarily do such a thing. Degree of competition, imperfect information, commitment to long-lived capital equipment and facilities, elasticity of substitution of capital for labor, influence of the relative movements in factor price and, most of all, the expected profitability of the innovation, are the type of influences responsible for the final decision in each firm and for that matter, for the rate of diffusion within a given industry.

If there is no analytical procedures to determine optimum decision criteria for an industry operating in other

than first-best conditions, the problem is further complicated when decisions have to be analyzed allowing for inter-industry relationships. In accordance with the concepts presented in the last section of Chapter III, the meaningful frame of reference for studies of food marketing in developing countries is the entire system, production-distribution-consumption, rather than a single industry. So that we will be dealing with a set of economic activities which are better defined by Shaffer as "a meaningful and manageable grouping of economic activities related vertically and horizontally by marketing relationships."[35] This definition cuts across or includes several industries and weakens the importance of the concept of substitutability among products, usually a factor in the delineation of the boundaries in an industry. In this moment to embark on theoretical considerations with respect to optimizing criteria in a system or subsector context would direct this analysis into grounds that are beyond its scope and purposes. Therefore, a presentation of problems encountered in the measure of costs and returns will be postponed until the next chapter and, for the present, a brief, non-systematic elaboration of some seemingly significant concepts in the economics of diffusion of innovations in marketing systems is shown.

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[35]James D. Shaffer. "On the Concept of Subsector Studies," Unpublished paper, Dept. of Agricultural Economics (East Lansing, Michigan: Michigan State University, 1970), p. 4.

We may think in three types of food loss reduction innovations, according to how much specific they are with respect to a certain stage in the system.

1.   For example, the introduction of a new technological process for canning foodstuffs is clearly an innovation pertaining to the processing stage. There are of course, backward and forward linkages. Sometimes changes in crop varieties or in the ripeness for harvesting are required, and the demand for the canned product also has to be considered if the new process introduces changes in the final product. However, the decision of adopting the new process is basically in the processors' hands. Thus, the economic analysis can be restricted to that dimension, maybe using the procedures developed in industrial organization studies.

2.   Innovations such as an improved package are likely to pervade a good part of the marketing system. They are apt to be present from the very farm field until the wholesaling distribution or from some stage in the assembly process until the point of last purchase. Under these circumstances it is less clear how to approach the assessment of efficiency for the whole system. At first glance a piecemeal approach seems appealing since each component part of the system could be analyzed as an industry in itself. Upon few occasions this might be appropriate for the presence of vertical integration, coordination and externalities will be, in most cases, compelling to undertake

a more global approach. Lamentably there are no clear ways to account for the costs and benefits associated with such phenomena. Yet firms consciously seeking for mechanisms of coordination (and integration is an extreme case of co-ordination) will have serious difficulties in the estimation of their costs and benefits. So that, the basic approach will have usually to be very similar to that of the first category of innovations. But this time, whenever the circumstances warrant, additional efforts must be made for at least imputing some values to the most evident costs and benefits accruing from activities undertaken by other industries in the subsystem.

3. A third type of innovation, in some aspects overlapping with the previous one, is characterized by its resemblance to the so-called public goods. They usually have to be provided by the government and their costs can be partially or totally external to the firm. One example that comes immediately to mind are roads. Construction or improvement of roads tend to be associated with the idea of expanding production, but they also have a significant impact in reducing food losses. Products spend less time in travel and the travel is less rough, both factors contributing to save food from wasting. Additionally, the new road facilities by decreasing transportation costs may induce farmers to market products that otherwise could have been diverted to other uses or simply left to rest in the field. New, more

modern means of transportation may be attracted, further enhancing the food loss reduction. Roads do not represent a direct cost to users (unless they were toll roads). Their benefits, though primarily appropriated by a relatively reduced number of market participants (e.g., farmers, truckers, merchant-truckers), lately will be reaching other participants in the market.

It is easy to notice the similitudes between this type of innovation and the institutional innovations mentioned at the end of the previous chapter. The analysis of benefits and costs in the provision of public innovations is, in general, subject to different considerations than the analysis of the private ones, and it is not a concern in this paper.

Encompassing this simple classification of innovations, a more general model can be applied. According to Parker (1) the greater the number of firms in an industry adopting an innovation the greater the probability that it will diffuse to the remaining firms; (2) the expected profitability is directly related to the probability of adoption; (3) if equal profitability is expected, the size of the investment will affect the probability of adoption; and (4) holding profitability constant, diffusion will vary depending on the characteristics of each industry. All this can be summarized as follows:[36]

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[36] J.E.S. Parker. The Economics of Innovation (London, England: Longman Group Limited, 1974), p. 113.

$$\lambda ij(t) = fi \left(\frac{Mij(t)}{Nij}, \pi ij, sij \ldots \right)$$

where $\lambda ij(t)$ is the proportion of firms not using the inno-

vation at time t, that introduce it by time t + 1

Nij is the total of firms for the jth innovation in

the ith industry

Mij(t) is the number of firms having introduced this

innovation at time t

πij is the profitability of installing this innova-

tion relative to that of other investments

sij is the investment required to install this inno-

vation as a percentage of the average total assets

of these firms.

This conceptual model looks very simple, however, it is use-
ful to remember some basic elements in the process of diffusion
of innovations, each of which has evident policy implications.
The model indicates the conditions in which diffusion is
more likely to occur. It also expands Scherer's threshhold
concept of the most favorable climate for rapid technological
change, in the sense that it suggests the existence of a
strategic degree of diffusion which assures the attainment
of a rate and spread in the subsequent diffusion process.

Finally, with respect to firm size, degree of com-
petition and their effects in the diffusion of innovation,
it is worth reviewing some concepts illustrated in the follow-
ing graph:[37]

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[37]William J. Shepherd. The Economics of Industrial
Organization (Englewood Cliffs, N.J.: Prentice-Hall Inc.,
1979), p. 396.
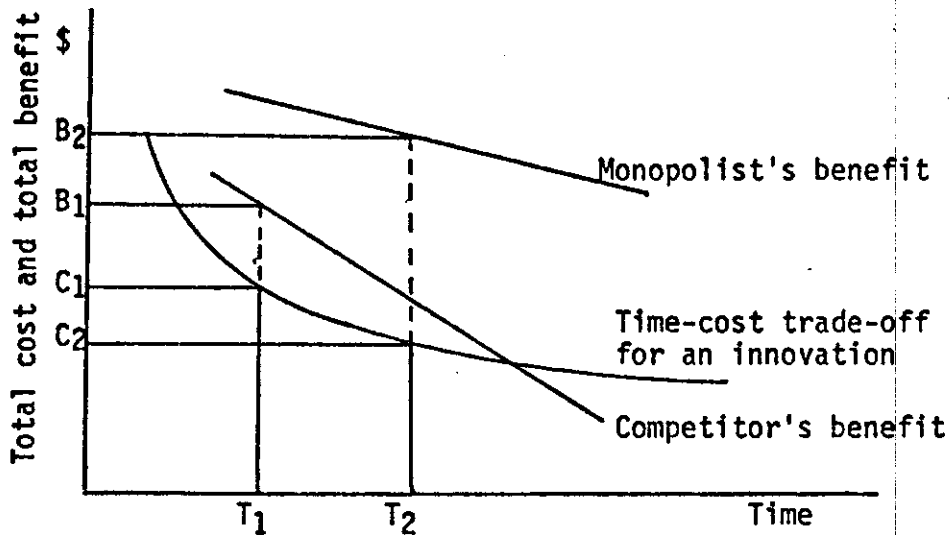
This diagram includes both monetary and time dimensions. The time-cost trade-off curve represents the alternative between adopting an innovation very quickly at a higher cost or taking more time at a lower cost. The possibility exists that this curve might be lower for the competitive firm. The benefit curve for a monopolist is higher and flatter than that for a competitor because the first will capture all the benefits of an innovation, over an extended period of time. For a monopolist the time to innovate (T_2) comes later since he waits until the moment when his net benefits are greatest (i.e., when the distance between total costs and total benefits is greatest).

This analysis suggests that diffusion of innovations will take place first in relatively small firms in the industry while the larger firms will adopt a more conservative attitude. The empirical evidence in developed countries confirms this tendency in most cases. But the same may not

apply to developing countries, where the competitive pres-
sures in markets made up by large numbers of small firms
have had no effect on reversing the traditional conservative
business practices. In terms of the above diagram, it
might be that the benefit curve of the available and/or
known innovations for the small competing firms be laying
to the left and below the time-cost trade-off curve.

Remarks

The neoclassical theory considers technological
change as the passage from one efficient process to a new
and more efficient one. This is, only efficient processes
enter into the manager's decisions. In reality, we cannot
be sure that changes only take place between efficient pro-
cesses. However, whichever is the case, for a change to
occur the ratio of benefits to costs with the new process
should be greater than the previous ratio.

In developed countries food loss reduction innova-
tions could imply smaller total revenue received by pro-
ducers under certain circumstance, e.g., inelastic demand
and nonexistence of a compensatory increase in demand for
the commodity in question. But this is less likely to
happen in developing countries, specially if we are dealing
with staple commodities whose income elasticity of demand
is relatively high.

Income elasticity of demand for marketing services
is high as compared with the income elasticity of demand
for the products themselves. While this is usually true,

in some developing countries, and related to specific com-
modities and/or locations, the relation may be reversed.
In this circumstance it will be important to decide not only
what losses to reduce, and to what extent, but also by which
means, i.e., which are the services people are willing to
pay for.

Innovations denote risks, which, in turn, represent
a cost to the firm operator. Thus, larger firms are usually
in a better position for innovating. Such a situation is
aggravated in developing countries, where risks and uncer-
tainties in the marketing systems are proportionately higher.
On the other hand, although concentration is commonly associ-
ated with larger firms, the evidence shows that only light
degrees of concentration favor innovations.

The ratio of benefits to costs is likely to be lower
as calculated by a firm operator than by an outsider. The
difference being the distinct perception of risks and the
costs associated with them. Additional problems arise in
the estimation of intangibles and costs of transfer. In
many cases these considerations will make the difference
between acceptance and rejection of an innovation.

In the study of improvements in marketing systems
performance, and food loss reduction is one dimension of this,
the meaningful category of analysis in the subsystem rather
than the industry. However, there are no clear ways for
measuring and evaluating the benefits of food loss reduction

innovations in a subsystem perspective. The classification of innovations as industry-specific, system-specific and public goods (services) may be of help in the economic analysis of them.

Some of the practical problems encountered in the instrumentation of the economic analysis of costs and returns of food loss reduction innovations are elaborated in the next chapter. Additionally, the relation between the economic considerations in the adoption and diffusion of innovations and the policies intended to reduce food losses is illustrated by means of some examples.

V.   PROBLEMS OF IMPLEMENTATION

Thus far in this paper, the discussion has turned around the suitability of some analytical tools and the applicability of some well-known theories in economics to the food loss reduction problem. This has been at a large extent a theoretical exercise. In this chapter the attention is directed toward the practical problems encountered by firm managers in the application of the theoretical concepts. In addition, the second section is devoted to a brief analysis of some alternatives in policies aimed at fostering the adoption and diffusion of food loss reduction innovations.

The Measurement of Costs and Revenues

The expected profitability of an innovation is a key factor in the final decision concerning innovation. And the maximum profitability is reached by setting output production at the point where marginal costs equal marginal revenue. However, there are practical problems for managers to work with these concepts.

The concept of profitability of an innovation is more apt to be dealt with in an intuitive manner. In other words, we may think of a skillful and experienced manager

doing rough estimations and coming up with an acceptable
approximation about the payoffs of an innovation. But
profit maximization criteria cannot be handled in the same
way. It involves the understanding of more abstracts
concepts (e.g. marginal cost and marginal revenue) and of
the very precise relationships between them. So that, in-
tuitive approximations to profit maximization is hard to
expect. Some people have agreed that there exists a sub-
jective understanding of what should be done to maximize
profits. This kind of innate behavior has been quickly
dismissed by economists such as Scherer, who says that the
argument practically amounts to transforming the theory of
profit maximization into a simple tautology.[38]

Stanton speaking about marketing firms in the United
States says: "Supply and demand analysis as a basis for
price setting has enjoyed only limited use. Business people
usually claim that more and better data are needed for plot-
ting the curves exactly. Supply and demand analysis can
be used, they feel, to study past price movements, but it
cannot serve as a practical basis for setting price."[39]
This lack of applicability is also reflected in most of the

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[38]F.M. Scherer. Industrial Market Structure and
Economic Performance, op. cit., p. 28.

[39]William J. Stanton, Fundamentals of Marketing, (New
York, N.Y.: McGraw-Hill Book Co., 1978), p. 269.

basic business textbooks in which profitability is treated in accounting rather than in economic terms.

In developing countries marketing firm managers are not only poorly informed but we will hardly find one or two of them with a crude understanding of the economics of profit maximization. Most managers work based only on subjective estimates and guesses.

Generally speaking, in developed countries the market conditions can be characterized as of imperfect competition, with degrees of concentration which encourage firms in trying to manipulate the demand by means of advertising and other ways of non-pricing competition. However, this is not the situation in developing countries. These suffer less the problem of concentration and food products are usually less processed, which in turn makes more difficult to go to product differentiation. Even though some marketing firms may enjoy an oligopsonistic position in the assembly markets, it is very likely that these will be later facing competition in the markets for their products. Therefore, in developing countries the demand conditions for food products saved from wasting is an element very much given to the firm. And this will probably be the common situation for most marketing firms moving low volumes, with low financial and managerial capabilities and, consequently, with short time periods of planning. For larger firms, committing themselves to more significant investments, the recoupment

period is much longer, although the predictive capability
does not increase proportionally. There is a sharp drop
in accuracy of prediction with each year added to the time
period of planning.

Taking into account these market characteristics
in the demand side, uncertain as they are, marketing
firms decide about their production processes and by exten-
sion, about their supply functions.

If consumer demands are relatively stable within
the usual range of planning for most marketing firms, the
same cannot be said about the demand for marketing services.
This tends to be more fluctuating throughout the year.
Firms adjust to fluctuations by varying the length of opera-
tion and the rate of output, and both mechanisms have a
great influence in determining the long run scale of opera-
tions.[40]

When firms decide to innovate they are deciding
about a new production function for them and hence, setting
new cost curves. From that point on the challenge is to
produce and sell as much units as the optimization of bene-
fits requires (assuming that it is known how much that is).

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[40]This adds a new dimension to the measurement of
output and to the calculation of costs associated with them.
In short run there will be different cost curves
depending on the seasonal variations. In the long run the
average cost curve will not be an envelope curve embodying
the best part of each short run curve, but rather a kind of
"mean" curve (excusing the pun, it will be an average average
cost curve).

However, an additional complication arises from the fact
that few firms produce only one product or marketing service.
In order to deal with this problem, the multiple-product
production model provided by the neoclassical theory has
severe limitations. It is so general and the variables
involved are usually so many that it is impossible to cal-
culate the parameters based on the statistical data ordin-
arily available. Moreover, in many cases multiple-product
operations can be redefined and treated using single-product
relationships.[41]

Working with the single-product model a stage-by-
stage variant might be adequate for firms which are relativ-
ely complex. Instead of trying to approximate an overall
production function for the whole firm, the alternative
would be to break down the process in meaningful stages and
select the most efficient techniques for each of them.

Independently of the model chosen, there are two
broad methodologies for the specification and measurement
of the production and cost functions: (1) the use of account-
ing data, and (2) the generation of synthetic data.

Accounting data can be used for purposes of descrip-
tive analyses, which basically consist in the calculation of

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[41]Ben C. French. "The Analysis of Productive Effi-
ciency in Agricultural Marketing: Models, Methods, and
Progress." In A Survey of Agricultural Economics Literature,
Lee R. Martin Ed. (Minneapolis: University of Minnesota Press,
1977), Vol. 1, pp. 91-206.

point estimates of average costs and other parameters based on the information provided by the record-keeping system of each firm. More interesting is the econometric analysis of such information with views to estimate functional relationships. The criticism to this methodology is centered on (1) the peculiarities and lack of standardization of the accounting systems, (2) the impossibility of isolating the recorded information from, and show the influence of factors such as managerial performance or environmental conditions, all which make unreliable the extrapolation of information to the future, and (3) the inadequacy of using data generated by a firm in the analysis of others with lack of them, due to the inconsistencies referred in (1) and (2) above.

The synthetic approach, as its name implies, tries to generate or synthesize production and cost functions based on the specification of input-output relationships provided by the engineering, biology and similar sources. Although the synthesized functions do not reflect actual conditions in the firm, but rather the standard conditions in the model, this approach is particularly useful in cases of lack of accounting data in a firm. Furthermore, it is recommended when the purpose is to compare processes, this is to say, it would be an appropriate approach in the analysis of the economic impact of innovations. Unfortunately, two major limitations, its cost and requirement of greater analytical capabilities, make of this methodology difficult to use in developing countries.

The practical considerations for the measurement of cost and revenues hitherto presented in this chapter may give the impression that we are dealing with a matter totally inaccessible to the average marketing manager in developing countries. However, recognizing that the task is arduous, it is by no means impossible. The reduction of food losses requires improved technical-managerial innovations made available to business firms but also calls for parallel effort in increasing the present levels of managerial qualifications. There is no way of making significant gains in food loss reduction, or in other parameters of marketing performance, if rather simple analytical tools for economic evaluation are not incorporated to the management of marketing firms. It is difficult to think in the generation of conditions for continuous improvement in efficiency if managers do not have the means for evaluating alternatives and make efficient (profitable) decisions. Thinking in these terms I believe that, despite of its shortcomings, statistical analysis of accounting data is an adequate methodology for developing countries. Because of the lack of information, cross-sectional data, when available and used with precaution, may also be of value. The economic-engineering approach is not ruled out. Large investments and studies of improvements in a system wide perspective may make necessary for larger firms and governmental agencies to resort to this more complex but more efficient methodology.

Some Policy Options in the Promotion of Food Loss Reduction
Innovations

This section calls for a brief digression on the role
of public enterprise in a market economy. The emphasis given
in previous chapters to some of the neoclassical optimization
criteria does not have any connection with the implicit or
explicit theories of public enterprise usually associated
with the use of such criteria. The marginal analysis is
central in the solution of the problems of productive and
exchange efficiencies in a Paretial economy. Neoclassical
economists rely on market mechanisms for the allocation of
resources and by extensions of the theory, for the attain-
ment of a concordant distribution of income, stability in
the system and economic growth. As may be expected, they
attribute to government a de minimis role, considering valid
only activities such as to provide a monetary framework,
counter technical monpolies and neighborhood effects, main-
tain law and order, define property rights, enforce con-
tracts, and not much more.[42] Contrary to these views, a
more ample role of government is endorsed in this paper. It
is also envisioned a public action which seeking for the
growth in the national output, at the same time, makes
explicit the goals of equity in income distribution, effective

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[42]See for example, P.A. Samuelson. "Diagramatic Ex-
position of a Theory of Public Expenditure," Review of
Economics and Statistics, Nov. 1955; M. Friedman, Capitalism
and Freedom (Chicago: The University of Chicago Press, 1962),
Ch. II.

competition and speed of technical and social progress.[43]

Specifically in developing countries, a restrictive definition of publicly provided goods and a limitation of the governmental action to a passive role of law and order caretaker do not seem adequate options. Therefore, public policies aimed at promoting food loss reduction are not seen exclusively connected with the provision of institutional innovations. The design and implementation of programs aimed at inducing private firms to the adoption of specific innovations is also regarded as an important sphere of public action.

Now, let's return to the main subject. Several times in this paper remarks have been made with respect to policy implications stemming from the analysis of the food loss reduction problem. For easy presentation, these can be grouped in two broad categories: (A) policies related to public innovations, and (B) policies related to the private financial and managerial capabilities for innovating.

A. As it was pointed out earlier institutional innovation is the generic term encompassing changes which are the result of public agency activities. These actions are intended to generate efficiency in the marketing systems or create a favorable climate for other innovations to take place. As

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[43]For similar views and additional references see P.O. Steiner. "The Public Sector and the Public Interest" in Public Expenditure and Public Analysis, R.H. Haveman and J. Margolis Ed. (Chicago: Rand McNally Co., 1977).

such, public innovations may affect a specific segment of
the market or they may have an overall impact. At the same
time, these innovations can be appropriated by the private
firms or they can remain as phenomena external to them.

The reasons for the existance of public innovations
vary. The most evident are: (a) divergences between social
and private returns, and more precisely, when social evalu-
ation shows the convenience of adopting an innovation but
the individual evaluation reflects an unprofitable result;
(b) because they are related to actions which normally fall
within the public agency or government domain, such as price
and tax regulation, enforcement of commercial laws and regu-
lations, sanitary and quality regulations and the like; and
(c) poor coordination in the marketing system.

(a) A typical example of divergence between social and private
evaluation is formed in the evaluation of information flows.
The relationship between efficiency and adequacy of informa-
tion flows in a marketing system is acknowledged and, how-
ever, at the individual firm level the payoffs of that func-
tion may be not so evident. The collection and dissemination
of market information is normally unprofitable yet as a
commercial activity.

Another example is training or education. Again,
the reason for negative attitudes towards even simple and
practical training activities or technical assistance are
found in the results of the process of private evaluation.

The individual firm operator may think that the benefits of additional training do not compensate for the monetary cost or the cost in terms of time he will have to incur.

In both examples, the provision of public innovations will represent a subsidy to the private activity and whose benefits will be expected to accrue to society in the form of an improved efficiency pervading the whole marketing system.

(b) Many people disagree with the character and extension of the governmental intervention in the marketing processes. The fact of the matter is that the intervention exists and then, it would be preferable to find out how this turns out to be the most effective possible.

Public programs may have direct or indirect effects in the reduction of food losses. And when there are multiple objectives, the most likely situation in public programs, the interactions are unsuspected. For instance, in virtue of sanitary regulations the distribution of milk can be forced to be made in a special type of container and sale in bulk to the final consumer prohibited. The measure if correctly enforced, may have any or the three following effects: (1) less producers bringing milk to the market if the additional costs are partially passed on to them, (2) reduction in the capacity of distribution due to the exit of those intermediaries who are unable to comply with the new regulations, and (3) since higher prices are likely, reduction in

the consumption of milk. The original idea could have been
to reduce losses of milk in quality and quantity, and pro-
mote public health. And in percentages the measure may be
a success. However, a reduction in the percentage of losses
not coupled with an increase in the absolute amount of food
available for consumption will not be a real solution to
the food loss problem.

(c) Weak coordination can preclude the adoption of improved
technical-managerial innovations in a marketing channel
if the cooperation and acceptance of many people is indispens-
able. An individual firm may find profitable and be willing
to adopt an improved package or some type of grading system,
but at the same time, find no echo in the rest of the channel.
In these cases institutional innovations in the form of
information, regulations and credit may be called for.

B. The relationship between the financial and managerial
capabilities of the firm and the process of innovation has
been a concern many times in this paper. The most sugges-
tive consequences and extensions of this relationship can
be summarized as follows: (a) innovation implies some degree
of risk which, in turn, signifies a cost to the innovator;
(b) larger firms are, in general, in a better financial posi-
tion for bearing the risk (and the cost) of innovations;
(c) larger firms have usually better management since growth
can be a consequence of it or, what is more likely, larger
firms have the financial capability for hiring good managers;

(d) although firm size and concentration have commonly a positive correlation, only slight degrees of concentration have been found to favor, in occasions, innovative behavior; (e) having the financial and managerial capabilities, firms relatively small and competitive tend to innovate earlier than their larger and more dominant counterparts; and (f) efficiency in the process of innovation is not unequivocally related to the scale of the firm.

Some of these points look contradictory or, at least, inconclusive. In fact, they are not. They represent tendencies which are always present and interacting. Under given circumstances one will take predominance over the others. The only safe conclusion that can be drawn is that not all firms can be induced to adopt the same type of innovation. This being a very simple statement is far from irrelevant. It is a good starting point for a review of critical implications, similar to the summary above, used this time as a checking list in the design of programs. Perhaps some examples may help to illustrate the point.

A food loss reduction program may have been directed toward small firms due to distributional objectives, or because the market consists primarily of firms of this size. According to our checking list, in this type of program there are some basic conditions that should be met, e.g., the capital investment should be minimum (the larger the capital commitment, the more the risk); any benefits from the innovation should be apparent after a relatively short period of

time; extension services and other ancillary services should be implemented in order to add to the managerial capabilities and diminish the risks. A similar program but now oriented toward larger firms does not need meeting these conditions to the same extent. However, new demands may appear. Additional sources of credit and a different management of it may be an important aspect of the program in this case rather than the extension services.

Economics of scale and know-how make certain industrial processes adoptable only by firms having enough size and managerial capability. But programs should not be misled by these concepts. At times economics are achieved at very small scales of operation and there are no further gains in efficiency by going to larger sizes (and deseconomies of scale are not a surprise in such circumstances). When this phenomenon is present, it would be interesting to find out what kind of financial services would put all firms in similar conditions for the adoption of the proposed changes. The evidence suggests that, within certain limits, smaller firms will innovate first, characteristic that can be used in the acceleration of the process.

Before leaving this topic a few words about the equity considerations in food loss reduction policies are warranted. If we want to assure the success of a program by favoring the adoption of innovation by firms which are financially strong and can provide channel leadership, we have to ask ourselves in what measure we are inducing

concentration and the appearance of "monopoly" earnings. There will be usually other alternatives, each of which will imply a difference in the speed of the process, or in the range of distribution of the direct benefits, or in the cost per unit of food saved, etc. These trade-offs will lead us to formulate questions such as: What do we want to save from wasting? To what extent are reductions in loss technical and economically feasible? How will the benefits be distributed among the different market participants? How will the costs be distributed among them? How fast are the changes required or desired? The answer to these questions will be defining the structure of the programs and, at the same time, determining the magnitude of the impact in the welfare of the people affected by them.

VI. CONCLUDING REMARKS

Improving the efficiency in the food distribution systems is a basic requirement in the solution of the food problem. And the reduction of losses occurring during the marketing process will be a central objective in any effort with this aim.

However, the reduction of food losses is not a cost-less process and whereas it may constitute a highly desirable objective from the advantage point of society, it will become a reality only if it is adopted by private decision units.

Increased efficiency, and specifically food loss reduction, can be achieved by adopting improved technical-managerial innovations. In turn, if innovations are to be adopted, they have to be preceived as profitable by the firm, whichever way the assessment is done.

The assessment of profitability in the adoption of innovations is difficult due to the unpredictable vagaries of the future. The impact of risk and uncertainty is further enhanced in developing countries. Inadequate information for the prediction of demand and the lack of recorded information within the firm for the estimation of alternative cost configurations, is the most usual situation.

The neoclassical theory in economics provides guidelines for profit maximization decision making at the firm level but is very insufficient when the focus is directed toward the aggregate of firms, that is, in the process of diffusion of innovations.

Therefore, the proper framework for the analysis of the economic considerations in the adoption and diffusion of food loss reduction innovations has to be expanded to include other theoretical approaches. These are less refined than the neoclassical theory but give more insights for comprehensive marketing systems studies, particularly in developing countries. The theory of effective competition and the systems approach to marketing studies are two examples of this.

Despite the severe limitations in the practical use of the theoretical tools by marketing firm managers working under real-world conditions, it seems that some headway can be made in that direction. The benefits of increased analytical abilities are clear. The possibilities for technical-managerial changes become greater when the evaluation of alternatives is considered reliable by those who take decisions and bear the cost of a miscalculation.

Although the applicability of some of the analytical categories discussed in this paper are likely to come very slowly to use in private decision making, we have to consider that public agency activity can add to the internal managerial capabilities by the design and implementation of programs for the benefit of private firms.

The use of accounting and synthetic data in the estimation of production and cost functions is feasible. If yet modest improvements in the analysis of movements in the demand side are achieved, some significant gains in the economic analysis of the process of adoption and diffusion of food loss reduction innovations can be expected.

Cost-benefit analysis is the usual technique in program or project evaluation. It is used with preference in the ranking of projects with purposes of allocating scarce resources. It is used less for determining the level at which a plant should operate or the combination of output it should produce. In both cases, it works within the optimizing criteria of the neoclassical theory. However, the technique is limited in that it approaches the optimum in a discrete fashion. Usually the achievement of a favorable ratio is considered sufficient. In this way, of course, it would add excessively to the cost of analysis the calculation of many point estimates so as to assure that the result is close to the optimum.

It is here that the analysis of the cost and revenue functions may prove useful. As long as we can know the optimum point for production (or a reasonable approximation of it) we are in a better position for reshaping programs in order to approximate such a point. In this paper several concepts have been presented with the purpose of giving an idea about the possibilities and limitations of this type of approach.

BIBLIOGRAPHY

BIBLIOGRAPHY

Adams, J.M. The Estimation of Post-Harvest Losses in Durable Commodities - Basic Principles. IICA/OEA, Seminar on the Reduction of Post-Harvest Food Losses in the Caribbean and Central America. Dominican Republic, 1977.

Bourne, Malcolm C. Post-Harvest Food Losses - The Neglected Dimension in Increasing the World Food Supply. Cornell International Agriculture Mimeograph 53. Ithaca, N.Y.: Cornell University, 1977.

Darrah, L.B. Food Marketing, New York: The Ronald Press Co., 1971.

Da Silva, Carlos A. A Methdological Basis for the Evaluation of Marketing Losses of Foods in Developing Countries. Plan B paper, Department of Agricultural Economics, East Lansing, Michigan: Michigan State University, 1979.

French, Ben C. "The Analysis of Productive Efficiency in Agricultural Marketing: Models, Methods, and Progress," A Survey of Agricultural Economics Literature, Lee R. Martin Ed., Minneapolis: University of Minnesota Press, 1977, Vol. 1.

Friedman, Milton. Capitalism and Freedom. Chicago: The University of Chicago Press, 1962.

Greeley, Martin. Economic Evaluation of Programs to Reduce Post-Harvest Food Losses, Unpublished paper, Institute of Development Studies, Sussex, England: University of Sussex, 1977.

Harrison, Kelly et al. Improving Food Marketing Systems in Developing Countries: Experiences from Latin America. Research Report, No. 6, East Lansing, Michigan: Michigan State University, 1974.

_____. Fomenting Improvements in Food Marketing in Costs Rica. Research Report No. 10, East Lansing, Michigan: Michigan State University, 1976.

Hirshleifer, Jack. Price Theory and Applications, Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1976.

Houck, James P and W. Barr. "Will There Be Enough?" Your Food, A Food Policy Basebook, CES Publication No. 5, Columbus, Ohio: The Ohio State University, 1975.

Lele, Uma. The Design of Rural Development - Lessons from Africa, Baltimore, Md: John Hopkins University Press, 1975.

Lipsey, R.G. and K. Lancaster. "The General Theory of Second Best," Review of Economic Studies, Vol. 24, No. 63 (1956-1957).

Moran, Michael J. Transfer of Post-Harvest Technologies to Small Farmers. IICA/OEA, Seminar on the Reduction of Post-Harvest Food Losses in the Caribbean and Central America, Dominican Republican, 1977.

Parker, J.E.S. The Economics of Innovation, London, England: Longman, 1974.

Riley, Harold et al. Food Marketing in the Economic Development of Puerto Rico. Research Report No.4, East Lansing, Michigan: Michigan State University, 1970.

Samuelson, Paul A. "Diagramatic Exposition of a Theory of Public Expenditure," Review of Economics and Statistics, Nov. 1955.

Scherer, F.M. Industrial Market Structure and Economic Performance. Chicago: Rand McNally, 1970.

Schermerhorn, Richard W. Economic Issues Associated with Food Loss, A.E. Extension Series 203, Moscow, Idaho: University of Idaho, 1976.

Shaffer, James D. "On the Concept of Subsector Studies," Department of Agricultural Economics (mimeographed), East Lansing, Michigan: Michigan State University, 1970.

Shepherd, William G. The Economics of Industrial Organization, Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1979.

Spurgeon, David. Hidden Harvest. A Systems Approach to Post-harvest Technology, Ottawa, Canada: International Development Research Center, 1976.

Stanton, William J. Fundamentals of Marketing, New York: McGraw-Hill Book Co., 1978.

Steiner, Peter O. "The Public Sector and the Public
  Interest," Public Expenditure and Public Analysis,
  R.H. Haveman and J. Margolis Eds. (Chicago:
  Rand McNally Co., 1977).

Tomek, M.G. and K.L. Robinson. Agricultural Product Prices,
  Ithaca, N.Y.: Cornell University Press, 1977.

U.N. Food and Agriculture Organization, Prevention of Food
  Losses, Report C 77/19,Rome, 1977.

U.S. Committee on Agriculture, House of Representatives,
  Malthus and America, A Report about Food and People,
  93rd Congress, 2nd Session, 1974.

U.S. Comptroller General. Hungry Nations Need to Reduce Food
  Losses Caused by Storage, Spillage and Spoilage,
  Report to the Congress.