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Impact of Fair Average Quality Procurement Procedures and No Loss Policy on Public Sector Storage of Wheat

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IMPACT OF FAIR AVERAGE QUALITY PROCUREMENT PROCEDURES AND NO LOSS POLICY ON PUBLIC SECTOR STORAGE OF WHEAT

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Preface

Grain is not a dead entity like stones. Its storage requires care and planning like the housing requirements of other living things. It respires releasing heat and moisture and also absorbs heat and moisture from its surroundings. Its main function is to serve as seed to procreate its kind for the continuity of the species. Favourable conditions of heat and moisture trigger the natural phenomenon of growth of its embryo involving complicated enzymatic actions to release food for the initial development of the baby plant which it harbours. The food in seed, though provided by nature for the baby plant, is also food for other living forms like insects, birds, rodents, bacteria, and above all, human beings. The housing of grain should provide protection from these other forms and at the same time keep it cool and dry so that it may not start growing. It can thus be seen that storage of grain is a complex business which requires complete knowledge of all the involved elements.

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EXECUTIVE SUMMARY

The purpose of this report is to open public dialogue on wheat quality in Pakistan. The conclusions and recommendations of this report are intended to serve as examples of what can be done, and a means of soliciting input from those who will be affected by change.

As the preface indicates, wheat is a living organism subject to all the forces that affect life. Wheat for human consumption needs care and protection to maintain its nutritive values. The basic scientific principles of wheat storage are well known in Pakistan and their application to storage is not difficult.

There is evidence that wheat in public storage is poorly protected and subject to losses in both quantity and nutritive content. Conflicts exist between operating policies and the measures required to encourage delivery of high quality wheat to the procurement centers, and protection of wheat in storage.

This report examines the impact of the "Fair Average Quality: (FAQ) procurement procedures and "no loss policy" on the quality of wheat and performance of public sector institutions engaged in wheat procurement and distribution. The Fair Average Quality procurement standards and no loss policies have not been altered since their adoption. While these policies were essential correct when formulated, the environment in which they are applied has changed.

Sections I and II provide the background information on the wheat economy, the physical properties of wheat and flour, and definitions and methods for assessing storage losses. Section III examines public sector wheat storage in Pakistan. Section V, reports the results of a 1988 survey of wheat quality as it is harvested and enters the marketing system.

Section V is an assessment of the conflicts between the public sector policies and the interests of producers, flour millers, and consumers. Section VI, provides specific recommendations for policy changes and programs to implement the recommendations.

The general conclusions and recommendations are that the no loss policy should be replaced with record systems that reflect the quantity and quality of wheat in storage. This cannot be accomplished until the FAQ system is modified to included objective grading of all wheat purchased.

The present FAQ specifications describe wheat that is inferior to what is currently being produced. The buying procedures encourage adulteration of the wheat and irregularities in purchasing. An alternative grading system and implementation is offered in Technical Annex VI.

SECTION I

INTRODUCTION

Statement of the Problem

There is considerable evidence, to be cited throughout this report, that the public supplies of wheat in Pakistan are poorly protected during handling and storage and, as a result, suffer abnormally high losses in quality and quantity. At the same time, the quality standards under which the government currently procures its wheat lack consistency and, moreover, are only loosely adhered to. Consequently, producers have little confidence in the fairness and integrity of the procurement system; processors complain of irregularities in wheat quality; and consumers receive flour which is often characterized by a short shelf-life and disagreeable flavor.

These problems are largely due to (1) the present government procurement standards, known as the "Fair Average Quality" or FAQ specifications and (2) the "No Loss Policy" or NLP which does not permit changes in the quantity of wheat to be recorded between time of procurement and release. The NLP essentially relieves the management of wheat procurement agencies of any responsibility for losses or deterioration of wheat inventories.

This report examines the conditions now prevailing in the government procurement and storage of wheat and recommends measures to improve quality as well as minimize losses. Changes in the FAQ standards and "No Loss Policy" will constitute major steps towards these objectives.

Wheat Production and Distribution in Pakistan

Of all the food crops grown and consumed in Pakistan, none is more important than wheat. Wheat occupies over three times the acreage and produces more than twice the value-added of rice, the second most important crop. It takes up about 43 percent of the total area under cultivation and provides 33 percent of the gross value-added of crop output in Pakistan. Wheat based products are the staples of the Pakistani diet, accounting for over 53 percent of percent of the per capita caloric and 59 percent of the protein intake. (Technical Annexes I-A, I-B and I-C)

In each province, a Provincial Food Department (PFD) purchases, stores, and distributes wheat. In addition, a semi-autonomous government agency, the Pakistan Agricultural Services and Supply Company (PASSCO), performs the same functions in designated surplus areas for distribution to the deficit provinces.

The total fixed storage capacity held by the public sector exceeded 4.2 million metric tons in 1987. Temporary outdoor storage capacity, used during the procurement season, exceeds one million metric tons. The total private sector off-farm storage capacity, is about 150,000 metric tons. (Technical Annex I-H) Annual wheat production in Pakistan is in the range of 12.5 - 13.0 million metric tons annually. Of this amount, about one half is a marketable, off-farm surplus. The Provincial Food Departments and PASSCO purchase about 50 per cent of the

quantity sold off-farm (25 percent of the market supply) directly from farmers. An additional 15 to 25 percent of the off-farm supply is purchased by public agencies through market intermediaries; the itinerant traders (beoparis) and commission agents (pucca arthis). In sum, public agencies handle from 60 to 70 per cent of the total market supply in each year. Public agencies also handle all imports and exports of wheat. (Technical Annexes I-D, I-I and I-K)

Wheat Policy Objectives

Due to the importance of wheat in Pakistan's economy and the diet of its people, the government has instituted policies related to the production, storage, and distribution of wheat. In general, these policies have emphasized subsidies as a means of achieving wheat self-sufficiency and ensuring that low-priced supplies of ground wheat flour (atta) are readily available for low income and urban consumers. The deteriorating financial situation of the Pakistan Government, however, has forced reductions of these subsidies, as well as a reassessment of overall wheat production and marketing policy. The major objectives of current policy include:[1]

1. Continued efforts to achieve wheat self-sufficiency in production.

2. Gradual reduction of wheat marketing subsidies.

3. Increased participation of the private sector.

4. Improvement in operating efficiency in wheat marketing.

5. Promotion of technology development to encourage bulk handling.

6. Establishing adequate pricing policies to achieve the above objectives.

Two objectives which have not been emphasized by policy-makers and yet have national importance are the improvement of wheat quality and the reduction of storage losses. A thorough reassessment of the FAQ and NLP policies will not only promote the current objectives of the government but bring significant progress in the entire system of wheat production and consumption. Both the FAQ and NLP evolved under very different social, economic and technological conditions than those of today.

The FAQ standards originated in the colonial era. Private sector grain traders developed the FAQ to describe the quality of wheat available at the time of harvest in their respective producing areas. Potential buyers in distant locations were provided with each areas' FAQ specifications so that sales could be made without the buyers having to travel through the wheat growing region to inspect and buy their particular requirements. The grain traders were organized

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[1] As summarized by the Appraisal Mission, Asian Development Bank, Pakistan: Wheat Storage Project Memorandum of Understanding, April, 1988.

into grain exchanges, with Karachi, Multan, Lyallpur (Faisalabad), and Lahore being the most important. Each grain exchange had its own grading and pricing system, and contracts for future deliveries were made on the basis of FAQ. (Technical Annex I-L)

The No Loss Policy originated in 1942 in response to a wide spread famine in the sub-continent. The No Loss Policy was an administrative convenience in an emergency situation. The policy of not permitting losses was essentially correct for the time due to the low volume of grains handled and short storage periods.

Government wheat storage is largely supervised by politically appointed and civil service personnel who are not scientifically trained for the task. As the government assumed a large role in wheat marketing in the late 1950's, the FAQ and no loss policy became institutionalized. Despite its universal use, the Fair Average Quality has not been defined by law, nor have objective means for inspection and grading of wheat been officially sanctioned.

Few modifications have been made in the FAQ and No Loss Policies to adapt them to the needs of present day production, marketing, and consumption practices. Because the public sector handles and stores the major portion of wheat in the market, it must be capable of purchasing, storing, and delivering good quality wheat in an efficient and timely manner. The public sector should establish the grades and standards which will enable the private sector to function in an efficient manner.

The next chapter of this report provides the necessary back-ground information regarding the physical characteristics of wheat, its storage and handling requirements, the methods of calculating quality and loss, and the current procurement and storage situation in Pakistan. The latter part of the report discusses the FAQ standards and "No Loss Policy" in detail, as well as presenting recommendations for improving current procurement and storage procedures.

SECTION II

THE EFFECTS OF POST-HARVEST LOSSES ON WHEAT QUALITY

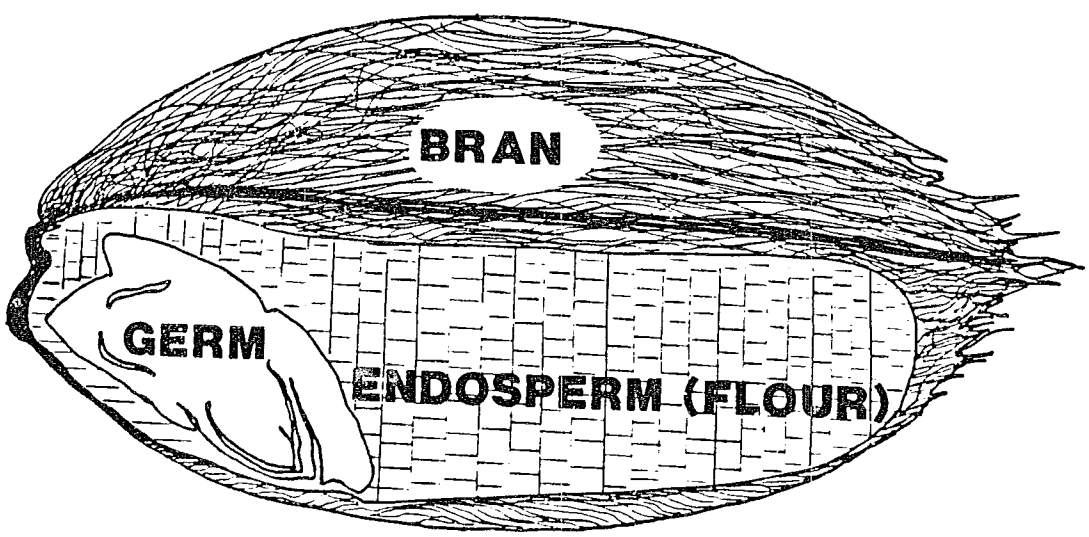
The Structure of Wheat

A kernel of wheat consists of three major structures: the embryo or germ of the new plant; the pericarp, or bran, which is the protective outercovering; and the endosperm which contains protein, starch, and other nutrients used by the new plant after germination. (Figure II-1) The physical characteristics of these structures are directly affected by storage and processing. (Technical Annex II-A)

The germ comprises about 2.5 percent of the kernel by weight, and is high in protein and oil. The bran contains vitamins, minerals, and most of the indigestible fiber. By weight, bran forms about 14.0 percent of the total wheat kernel, while the endosperm accounts for the remaining 83 percent. The endosperm consists of a protein matrix in which granules of starch are embedded. On the inner side of the bran coating, endosperm tissues contain a concentration of minerals called ash. The ash is less concentrated in the central portions of the endosperm. Information on the physical and chemical composition of Pakistan wheat varieties is contained in Technical Annex II-B and II-C.

Figure II-1

A KERNEL OF WHEAT



Source: FFGI

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Definitions of Post-Harvest Losses

The subject of post-harvest grain losses has been under intensive discussion since the 1970's. In September 1975, the Seventh Special Session of the United Nations General Assembly declared that "the further reduction of post-harvest losses in developing countries should be undertaken as a matter of priority with a view to reaching at least a 50% reduction by 1985".[2] At that time however, there was neither a universally accepted definition of post-harvest losses nor any recognized methodology for measuring them. Later on, however, in a multinational effort sponsored by USAID, Harris and Linblad compiled a manual of loss assessment methods. The manual is used in Pakistan, and studies within this country are comparable to those made in other parts of the world. Therefore, data on storage losses cited in this report have been gathered according to guidelines recognized by the international scientific community.

The most commonly accepted definition of grain loss and damage was developed by the National Academy for Sciences in the United States:

> The subjective term 'damage' denotes a condition that is not objectively measurable. It refers to apparent evidence of deterioration, and its importance to the consumer depends upon his economic level and cultural background. A poor family often has no alternative but to consume a certain amount of damaged food in its diet, whereas more affluent neighbors may be in a position to exercise selection.
>
> 'Loss' on the other hand, denotes disappearance of food and should be directly measurable in economic, quantative, and qualitative terms:
>
> Economic loss is the reduction in monetary value of food as a result of physical loss.
>
> Quantitative loss involves reduction in weight and therefore, can be readily defined and valued.
>
> Qualitative loss, although difficult to assess because it is frequently based upon subjective judgments (like damage), can often be described by comparisons with locally accepted standards.
>
> Nutritional and germinative losses, which may be a combination of loss of quantity or quality, are also difficult to measure.

Some grain loss authors use the terms "avoidable losses" and "unavoidable losses" to distinguish among the causes of changes in weight. "Avoidable losses" are those that could be minimized or eliminated by use of proper facilities and storage management, while "unavoidable losses" occur from drying or natural respiration which reduces the weight of each grain. Additional unavoidable

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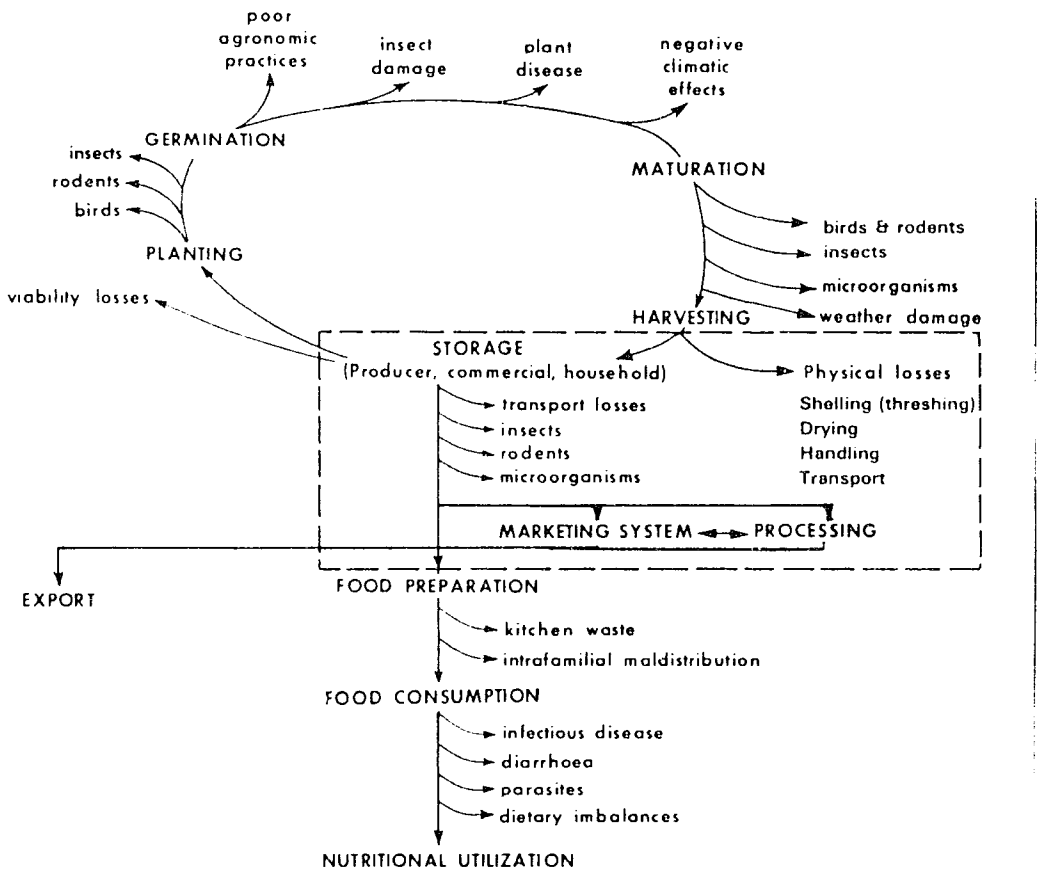
[2] Kenton L. Harris and Carl J. Linblad, Postharvest Grain Loss Assessment Methods, American Association of Cereal Chemists, 1978

losses occur each time grain is handled or moved. The term "invisible shrinkage" is frequently applied to handling losses.

Figure II-2 is a schematic presentation of the sources of losses in the grain production and consumption system. This report will consider only losses occurring within the box marked by the dashed lines, and more specifically those losses which occur in public sector storage, although some references will be made to on-farm losses and the private sector.

Figure II-2

LOSSES IN THE FOOD GRAINS SYSTEM



Source: Postharvest Grain Loss Assessment Methods, by Kenton L. Harris and Carl J. Lindblad, American Association of Cereal Chemists, 1978, p. 2.

Adjusting for Weight and Volume Changes

It is important to distinguish between (1) changes in weight and volume due to moisture and foreign matter and (2) reductions in dry matter and edible volume due to losses brought about by stored grain pests, moulds, and handling of the grain. Moisture and non-grain material or foreign matter, such as dirt, sand,

insects, leaves, stems, other seeds and the like can be added or removed at any time during the harvest, cleaning, drying, transport, and storage processes.

While the first category of weight changes indicates a "gain or loss", the actual amount of grain, that is dry matter, neither increases or decreases. The "gain or loss" is confined to two components that can be added or removed from the grain, namely water, or moisture, and material surrounding the grain which is not grain, in other words, foreign matter.

The reduction of dry matter that occurs during handling or through the actions of pests represents a true loss of grain volume and quality. Insects and moulds remove edible portions of grain and create grain particles, or dust, which seep through the bags or are thrown off into the air when the grain is moved.

Changes in Moisture and Foreign Matter Content. Precise calculations can be made of changes in foreign matter and moisture content. The mathematical formulas for determining the changes in weight due to the addition or subtraction of foreign material are identical to those used in calculating changes in moisture content on the wet basis. Where mechanical cleaning and drying are used in successive steps, the customary practice is to clean and then dry the grain, to avoid the cost of drying waste material. It is then necessary to multiply the volume factor after cleaning by the volume factor after drying to obtain a final volume of clean, dry grain. (Technical Annex II-D)

Two methods for calculation of moisture content are used, one based on the total weight of grain including moisture (wet basis) and the other based on the dry matter content of grain (dry basis). The wet basis is commonly used in grain storage and marketing; the dry basis in used primarily in science and engineering. Technical Appendix II-E presents the formulas and means of converting one basis to the other.

For most purposes, close approximations of weight changes can be made using charts and nomographs such as those presented in Table II-3. These are useful for persons working in grain storage who have limited training as well as for estimating costs and returns when grain value is calculated on the basis of moisture content. Micro-computer spreadsheet models are frequently used to determine optimum moisture and foreign matter levels for marketing purposes. Examples of how to use these charts, graphs, computer spreadsheets are shown in Technical Annexes II-F.

Reductions for Physical Losses. Reductions in volume caused by actual physical loss of grain cannot be approached in the same manner as reductions in volume and weight due to removal of foreign matter and moisture.

Physical handling

Many grain firms in other countries adjust their inventory figures by small percentages, such as 0.1 per cent, each time the grain is transported or rotated in bulk bins or for each month the grain is kept in storage. The percentages used in adjusting for losses during handling are developed through experience of the firm, or in some cases, are required by laws regulating the grain trade. While the percentages are very small, the quantities lost can be substantial in a high volume operation. (Technical Annex II-G)

Transport

Losses in transport occur as another form of physical handling, but the amount of loss varies according to mode of transport used, smoothness of transport, and time and distance of transfer. Some spillage or leakage of grain is to be expected when grains are carried in general purpose railway wagons or cargo trucks. In some cases, scientific studies have determined the extent of transport losses, but a more general practice is to use "rules of thumb" based upon experience or standards prescribed by law or trade associations.

Storage

In addition to weight losses or "shrinkage" stemming from changes in moisture content and handling, stored grains may also be subject to losses caused by insects, moulds, and vertebrate pests (birds, rats, mice, etc.) All three sources of loss can be reduced to acceptable levels by scientific knowledge, properly designed and maintained storage facilities, and dedicated management. Of the three sources, insects are by far the most common and cause the highest rates of loss and grain damage. (Technical Annex II-H)

A common means for calculating losses from insects and vertebrates is to record weights in and out of storage. This presents some problems in that live and dead insects, excreta, and dust remain in the grains, replacing some of the weight of grains consumed. Insect activity also increases the moisture content of grains, adding additional weight.

A more reliable means of calculating storage losses from insects is to take a sample of grains and separate into damaged and undamaged portions. Equal numbers of grains, damaged and undamaged, usually 100 to 1000 are weighed and the weight differences expressed as percentage of the undamaged grain.

In the field where weighing equipment is not available, some "rules of thumb" are used. A sample of 100 to 1000 grains is taken and the number of bored grains is noted and converted to a percentage. Depending upon the type of insect present, the percentage of bored grains is multiplied by a fraction to estimate total weight losses. For example, where the Sitotroga species is present in wheat, 1/2 is multiplied by the percentage of damaged grains to estimate weight loss. (Technical Annex II-I)

In estimating weight losses for birds, rats, and mice, various means are used to estimate the number of vertebrates present in the storage area, and use a grams per day factor times the estimated number. (Technical Annex II-G)

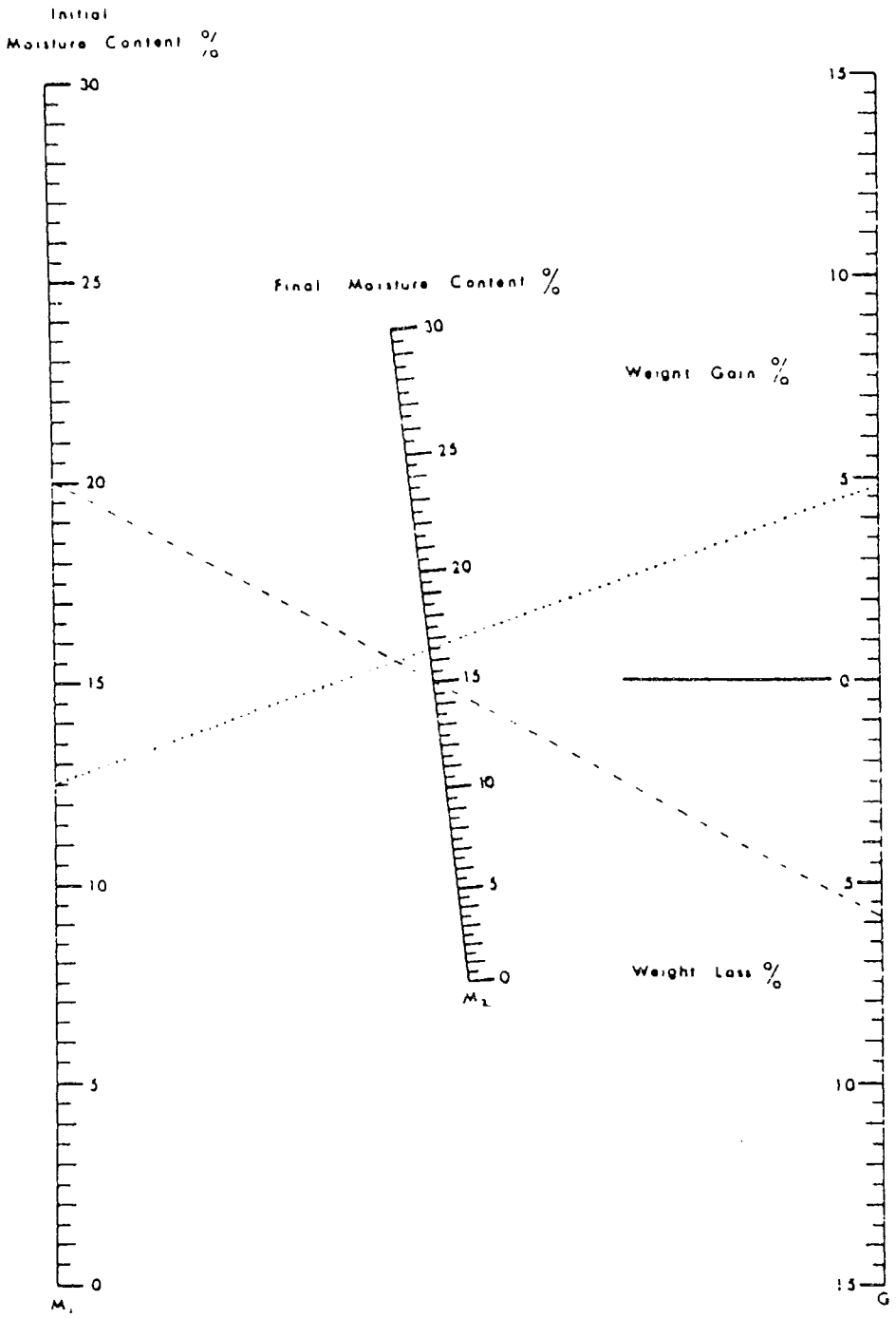
Interaction Between Grain Moisture and Climate

Changes in weight due to the interaction of the grains with the surrounding atmosphere can be calculated using complex sets of mathematical equations. For most purposes, psychometric charts are used, such as the simplified version in Figures II-4 and II-5. Knowledge of this interaction is necessary for the proper design of storage facilities, and storage management practices related to aeration and drying.

Figure II-3

EXAMPLES OF LOOKUP TABLES AND NOMOGRAPHS

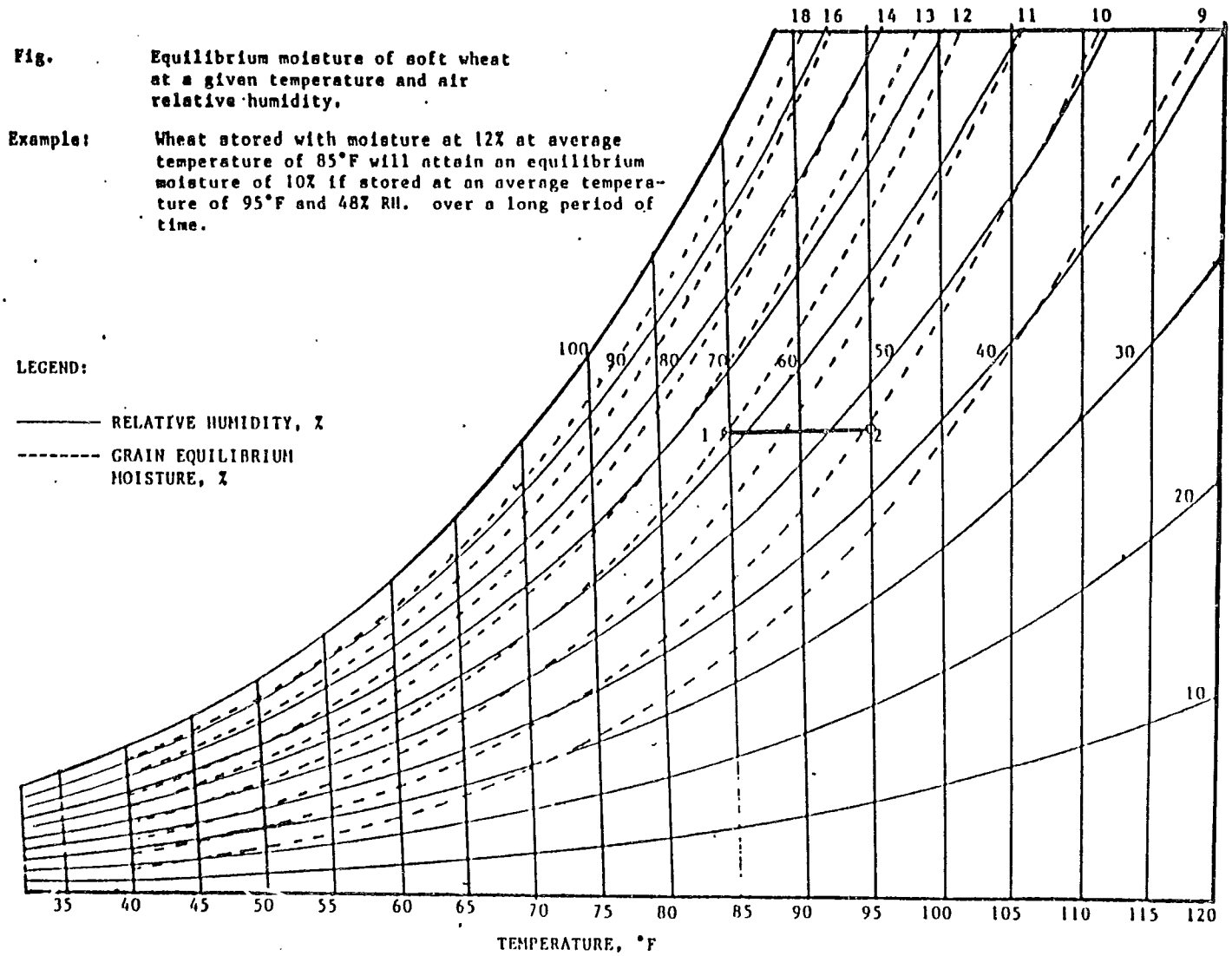
MONOGRAPH FOR CALCULATION OF GRAIN WEIGHT CHANGES
RESULTING FROM CHANGES IN MOISTURE CONTENT



Source: Postharvest Grain Loss Assessment Methods, by Kenton L. Harris and Carl J. Lindblad, American Association of Cereal Hemists, 1978.

Figure II-4

PSYCHOMETRIC CHARTS FOR ESTIMATING CHANGES IN MOISTURE CONTENT OF GRAIN



Flour Milling

There are two basic methods of flour milling, (1) grinding whole grains and (2) roller milling. Grinding whole grains produces atta, or whole wheat flour. Atta contains all the parts of the wheat kernel in the proportions in which they naturally occur. Roller milling, on the other hand, separates the grain into its basic components of (a) white flour which is mostly endosperm, and (b) bran fractions which include the other kernel structures.

Certain endosperm proteins, collectively called gluten, (Table II-1) provide elastic properties to the dough, allowing it to trap gas bubbles for leavened, raised breads and permitting it to be stretched thin without tearing for products such as chapati. In both white flours and atta, it is the gluten component that determines the texture of the baked product. Flours containing a high proportion of endosperm from close to the bran such as atta or high extraction[3] white flours contain more ash, as it is concentrated in these tissues. High ash content creates a dense, hard-baked product.

With roller milling systems, it is possible to produce flours extracted mostly from the inner portion of the endosperm. These flours have desirable protein characteristics with a low ash content. Such flours are used to produce high quality baked products.

Whole wheat products such as those made from atta in Pakistan contain more nutrients than products made from the "finer" flours because they contain nutrients from the bran and germ, as well as the endosperm. However, if the proportion of the inner-endosperm flour is too small, the baked product becomes tough and less palatable. Furthermore, the wheat germ's oil content can become rancid, leading to a short-shelf life.

Flour Quality in Pakistan

There is ample anecdotal evidence that flour in Pakistan is generally of low quality. Apart from the PARC data cited above, no nationwide assessments of flour quality are known to have been done in recent years. Several studies on wheat pricing and flour milling make references to the low quality of flour, although specific quality attributes are not identified.

A series of 11 working papers on a wheat marketing survey conducted in 1982 by Pakistan Institute for Development Economics and Erasmus University of Rotterdam notes "There seems to be no way to account for the poor quality of wheat sold through the rationshops." The quotation was in the context of an analysis of

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[3] The ratio of flour yield to wheat in roller milling is called the extraction rate. The rate is most often expressed as a index number. White flour yield is usually 72 to 80 kg flour per 100 kg wheat. (80/100) = .8 x 100 = extraction rate of 80. the higher the rate, the greater proportion of bran in the flour.

marketing margins for wheat flour sold by the public and private sectors.[4] Working paper No. 3[5] refers to a consumer survey in which 2/3 of the respondents criticized available flour as being of low quality.

Table II-1

TEST OF PAKISTAN FLOURS

QUALITY CHARACTERISTICS OF RATION AND COMMERCIAL FLOUR (ATTA)

CONSUMED IN ISLAMABAD AND RAWALPINDI

Location/ Source	Physical composition (%)		Gluten		Chemical Composition (%)					Farinograph			Chapati Quality		
	White flour	Bran	Wet gluten (%)	Quality	Moisture	Protein (dry basis)	Fat (dry basis)	Crude fibre (dry basis)	Ash (dry basis)	Abs. (%)	Dough Dev. (min)	Stability (min)	Colour	Texture	Average Acceptability
Islamabad ration shops	61	39	17	Low	15.5	12.1	2.0	2.3	1.7	50.8	16.5	5.0	Brown	Coarse but pliable	U
Murree ration shops	58	42	19	Low	13.5	12.5	2.2	2.2	1.7	62.7	12.0	7.5	Brown	Tough	U
Rawalpindi ration shops	60	40	17	Low	14.5	12.5	1.9	2.3	1.7	51.6	14.5	4.5	Brown	Tough	U
Kahuta ration shops	62	38	13	Low	15.9	12.2	1.8	3.0	1.7	57.5	15.5	2.0	Brown	Tough	U
Gujar ration shops	57	43	15	Low	15.5	11.8	2.0	2.9	1.8	57.5	15.5	2.5	Brown	Tough	U
Ibd:Rwa commercial	81	19	21	Moderate	14.1	12.2	1.4	1.8	0.0	57.0	6.0	12.0	Creamy white	Soft and pliable	S
Fine flour NARC Lab. milled flour	88	12	23	Moderate	12.1	15.2	1.9	2.5	0.0	71.0	5.0	2.7	Creamy	Slightly pliable	S

U = Unacceptable
S = Satisfactory

Source: PARC, Nutrition and Food Quality, Annual Report, 1985., p. 93.

[4] M. Ghaffer Chaudhry, Pakistan Agricultural Policy: Lessons From Recent Experience with Wheat Policy. Working Paper No. 5, Pakistan Institute of Development Economics, April, 1983, p.10.

[5] M. Ghaffwe Chaudhry, An Historical Survey of the Wheat Market in Pakistan, Working Paper No. 3, February, 1983, p. 5.

That flour quality has received low priority among flour millers was documented early as 1977.[6] The report found that most mills were lax or even indifferent about quality control procedures and that only two commercial mills in the entire country had laboratory equipment for testing the quality of their wheat and flour. Small improvements have been noted since the ration shop system was abandoned in April, 1987. Flour is now being transported freely between provinces and subjecting flour millers quality and price competition for the first time. Millers who failed to heed the changing situation may be among the 70 who have reportedly gone out of business in the Punjab since de-rationing.[7] Wheat damaged by the lesser grain borer and rice weevil typically contains a smaller proportion of the inner endosperm tissues compared to the proportions of bran and ash. (Figure II-6) The excreta of these insects creates disagreeable odors and flavors in wheat grains and can contaminate the flour if the grain is not rigorously cleaned before milling. Wheat infested by these two primary insects attract secondary insect infestations which add to the off-odors and off-flavors of the flour. Flour made from severely infested grains may make flour inedible as reported by a news item in Figure II-7.

Recap: Sources of Grain Loss

To understand grain losses, one must distinguish between the different causes of weight changes. Weight reductions caused by lower moisture content or by the removal of foreign matter do not change the quantity or quality of edible grains available for human consumption. Such weight changes can be calculated by mathematical formulas.

Weight losses caused by insects, moulds, and vertebrate pests, or by handling losses, on the other hand, do affect the quantity and quality of the edible grains. They are, however, more difficult to quantify. It is also difficult to calculate the resulting changes in nutritional value and processing characteristics.

The quality of wheat flour in Pakistan is generally low by international standards. In a free market economy, varying qualities of a product tend to be differentiated by price. This, in turn, provides the incentive for grading and quality control. Where government policies override market forces, however, such incentive are lacking and product quality suffers.

The next chapter examines some of the problems associated with the storage of wheat in Pakistan and their role in the loss of grain quantity and quality.

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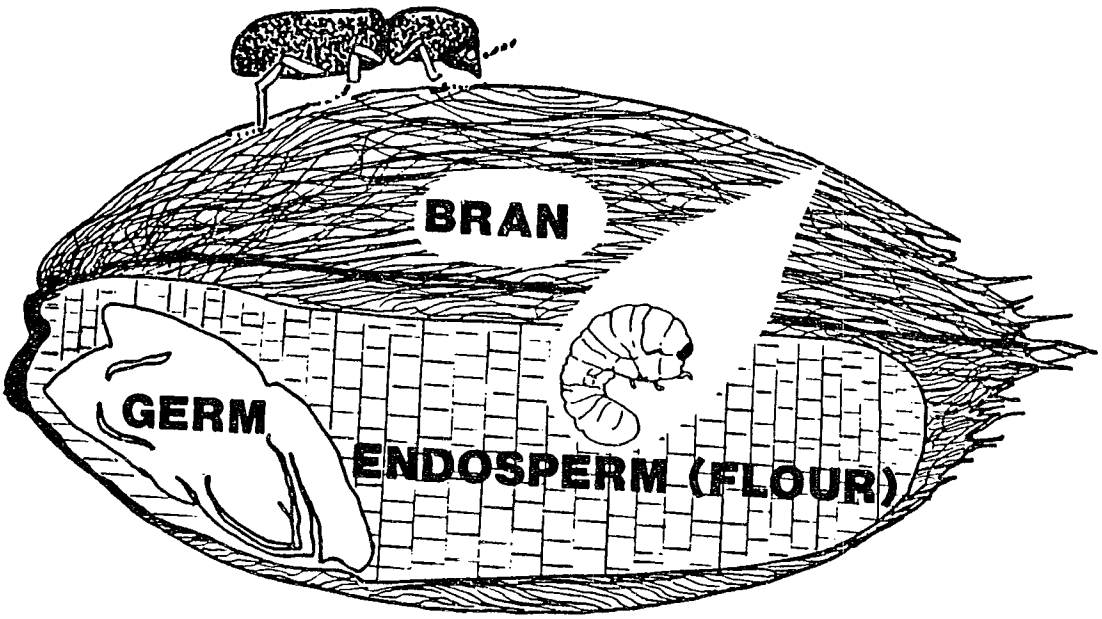
[6] MICAS Associates, Storage and Distribution of Wheat in Pakistan, Report Submitted to the Prime Minister of Pakistan,, Islamabad, May, 1976.

[7] 70 Punjab Flour Mills Closed, Pakistan Times, September 27, 1988.

Figure II-5

INSECT DAMAGE IN WHEAT



Composition of Kernel	Undamaged	Damaged*
Endosperm	83.0%	76.5
Bran	14.5%	20.0
Germ	2.5%	3.5

The larva utilizes the inner portion of the endosperm which is low in ash content. Bran and ash content will increase in whole wheat flour made from insect damaged grain. High ash content in flour causes the bread products to be tough and less palatable.

* With 1/3 of endosperm removed.

Source: FFGI

Figure II-6

NEWS ITEM ON FLOUR QUALITY

THE MUSLIM

Sunday, March 20, 1988

Murree Letter

From SALIM SHIWALVI

ADULTERATED ATA

Some brands of ata, in 18 kilo bags, being sold here are veritably adulterated. The 'roti' cooked of the ata gives a blackish look and is repulsive to taste. It is believed that the adulteration includes defective wheat or crumbs of 'roti' as is often reported in the press. The local administration owes an explanation to the citizens for not taking any action in this regard, so far. The real culprits, are, of course, the flour mill managements and not the local shopkeepers.

SECTION III

STORAGE LOSSES OF WHEAT IN PAKISTAN

Introduction

The Federal and Provincial Governments of Pakistan have created a paradoxical situation. The official procedures for procurement, storage, and distribution of wheat mandate a "No Loss " policy for all government stocks. The amount (and value) of wheat supplied to end-users must equal the amount originally procured. Hence, in principle, losses and deterioration of grain do not exist in government facilities.

On the other hand, storage losses in government stocks are being systematically documented by a Federal agency created specifically to "estimate the extent of quantitative and economic losses [in grain stocks]... and to advise the government on a future policy and programme for developing suitable storage facilities"[8] This agency, known as the Federal Grain Storage Research Laboratory (GSRL), was established by the Pakistan Agricultural Research Council in Karachi in 1981. The objectives of the GSRL are stated in Technical Annex III-A. Early in 1988, three related research organizations, the Grain Storage Research Laboratory, Federal Pesticides Laboratory, and Vertebrate Pest Institute, were merged under the name of Pest Management Research Institute (PMRI) and relocated to the University of Karachi.

GSRL has endeavored to adhere to internationally accepted methodologies and standards in the conduct of its research. Its efforts are to be commended for their objectivity and comparability to similar studies conducted in other parts of the world. This chapter is based primarily upon research conducted by the GSRL and cooperating institutions.[9]

Grain Storage Loss Assessments In Pakistan

Prior Loss Assessment Studies. The GSRL summarized 22 studies conducted between 1906 and 1980 on grain storage losses in Pakistan and the Asian subcontinent. The recorded losses ranged from 2 percent to 33 percent.[10] The consensus derived from this review was that losses to insect pests in grain stored 6 months or more averaged about 2.5 percent of the grain weight. The GSRL summary, however, made no attempt to assess losses in quality or nutritional value. Technical Annex III-B summarizes the extent and the causes of losses

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[8] GSRL Objectives

[9] Baloch et.al., "Losses in Public Sector Storage in Pakistan, Results of a Loss Assessment Survey 1984-85", PARC, 1986: Hafiz Ahmed et. al., "Protection of Bagged Grains Stored By Government Agencies in Pakistan - A scrutiny of the current practices and recommendations for improvement", PARC, GSRL Report No. 3, August, 1987, and Baloch et. al, Foodgrain Storage Research in Pakistan, Progress Report 1985-87, PARC, April, 1988.

[10] Hofiz Ahmed, Losses Incurred in Stored Grains by Insect Pests, Grain Storage Research Laboratory/PARC, July, 1984.

reported by studies conducted in Pakistan between 1977-1985. A composite estimate based upon these studies showed loss rates of 9 percent at the farm level, and 5 percent in both the private and public sectors.[11]

GSRL/PARC Volume Loss Assessment Studies. Major studies of losses conducted since the establishment of the GSRL are cited in footnote 9. These studies were conducted under the auspices of the World Bank. A summary of the major findings appears in the Table III-1.

The average storage period was about six months, during which the rate of grain loss in public sector godowns amounted to 3.5 percent. Since the rate at which losses occur is not constant, one cannot assume losses would be 7.0 percent over a 12 month period.

A comparison of weight losses prior to storage with those during storage illustrates the progressive deterioration of the wheat as it moves from surplus provinces to deficit areas in Baluchistan and N.W.F.P. By the time the wheat reached the N.W.F.P. it had already suffered losses from insects which amounted to nearly 3 percent of its weight before storage. The proportion of loss attributed to moulds was low, as can be expected under the ambient conditions of Pakistan.

Table III-1

AVERAGE WHEAT STORAGE PERIODS AND RATES OF LOSSES IN PUBLIC SECTOR GODOWNS IN THE PROVINCES OF PAKISTAN DURING 1984-85

Province	Average Storage Period (months)	Percentage Weight Loss			Total
		Insect		Moulds	
		Pre-storage*	Storage		
Sind	6.4	0.1	2.9	0.3	3.3
Punjab	6.3	0.1	1.8	0.3	2.2
N.W.F.P.	6.5	2.9	2.6	0.7	6.2
Baluchistan	2.6	0.5	1.2	0.5	2.2
Pakistan	5.4	0.9	2.1	0.43.5	

* Wheat received at the study sites had been stored elsewhere earlier.

Source: Baloch et al. Losses in Public Sector Storage in Pakistan, PARC, 1986.

[11] Agroprogress Kienbaum International GmbH and Indus Associated Consultants, Food Storage and Processing Study, Vol. 1, Final Report, Bonn West Germany and Lahore, 1987, p. 63.

Of the 3.9 million metric tons of wheat released by the provinces while this study was being conducted, the quantity lost was calculated to be 141,600 tons or 3.6 percent of the total.

As shown in Figure III-1, the losses calculated by PARC during the 1984-85 surveys indicated that insect infestation of stored wheat is a serious problem. Figure III-1 shows weight losses increasing at a linear rate of 0.353 percent per month in Sind.

Estimating Hidden Losses in Public Wheat Storage. Loss assessment studies in Pakistan use three standardized methods for calculating hidden grain losses.[12] In Pakistan, 1/3 and 1/4 are commonly used as multipliers (Baluch, p. 23) for estimating losses in grain infested by the wheat borers *R. dominica* and *S. oryzae*. For example, if actual weight loss is 3.2 percent, and damaged grains 16 percent, total weight loss would be calculated as 3.2% +(1/4 x 16%). The total loss is 7.2 percent. With the 1/3 multiplier, total losses would equal 8.3 percent.

Figure III-1 indicates the addition of dust, which represents a part of the "hidden" loss. Weight losses in grain stored for up to two years have reached as high as 15 percent.

Losses Due to Vertebrate Pests. At the time of the GSRL/PARC loss assessments, the participating institutions did not feel that they had adequate methodology for assessing losses caused by vertebrate pests. This aspect of storage loss was therefore omitted from their studies.

In 1986, however, the Vertebrate Pest Control Sub-Project of the Food Security Management Project conducted an extensive survey of losses caused by vertebrate pests in public storage facilities during 1986.[13] The survey found vertebrate pests (rats, mice, birds) in two thirds of the 349 godowns surveyed at a total of 120 sites. Volume losses were estimated to be 0.1 percent each for rodents and birds, or 0.2 percent overall. The study concluded that the vertebrate pest activity varied according to the physical condition of the godowns. The problem, accordingly, could best be corrected by a rehabilitation and maintenance program as well as further staff training.

Grain loss, however, is not as serious a problem as the contamination of stocks by fecal matter, urine, hair, and feathers. These contaminants represented a health hazard present in up to ten percent of all provincial godowns surveyed. PASSCO godowns appeared to be largely free of vertebrate pests. Only 7.4% of

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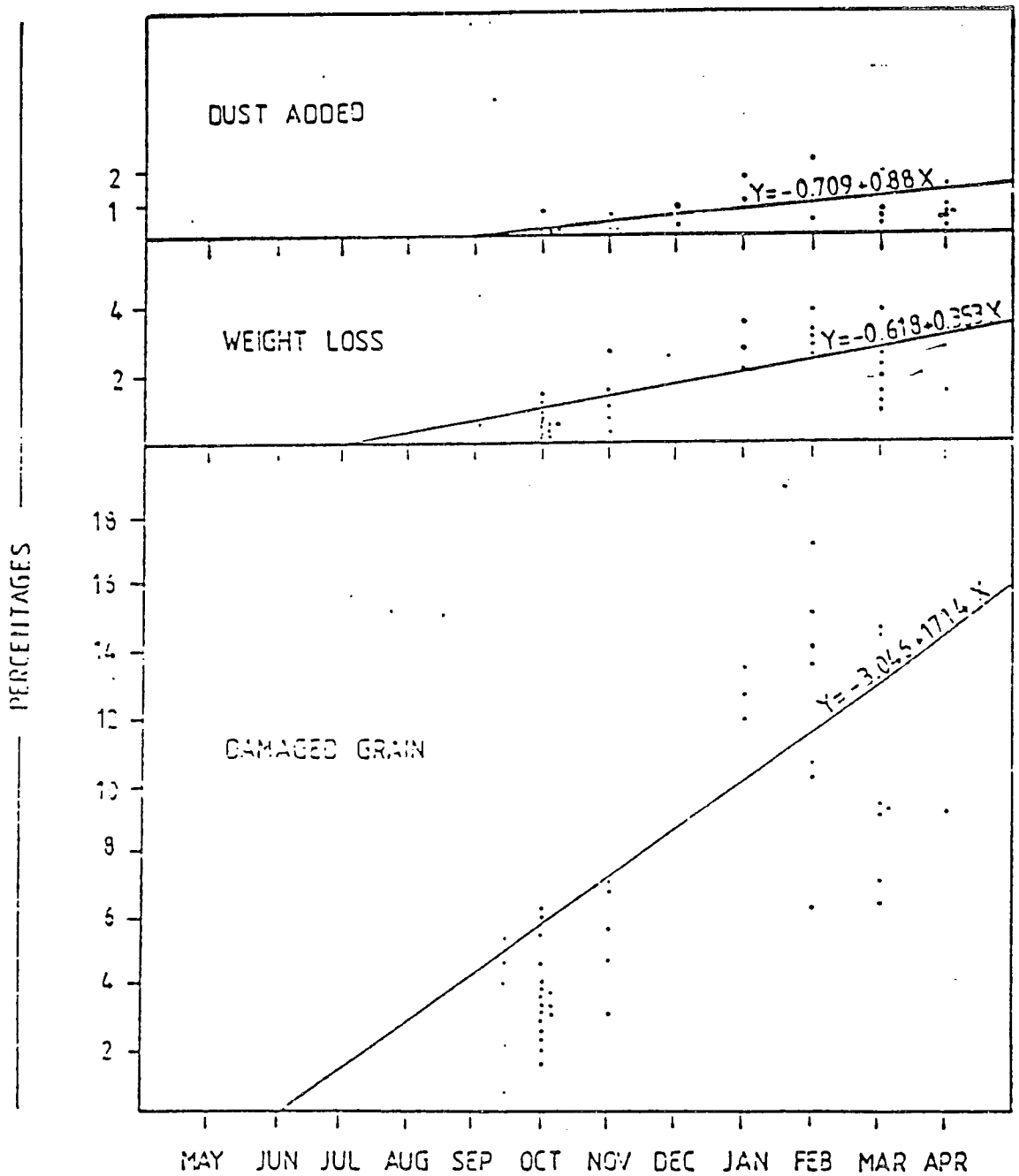
[12] Harris and Linblad,

[13] Joe E. Brooks and Ejaz Ahmad, Vertebrate Pest Infestations in Provincial Food Storage Facilities in Pakistan. Tech. Report No. 7, November, 1986. Report 7 is summary of Technical Report 2 Punjab, 4 (Sind), 5 (NWFP and Baluchistan). Technical Report 8 covers PASSCO. Subsequent reports cover urban private grain markets.

Figure III-1.

YEAR LONG OBSERVATIONS ON THE RATE OF DETERIORATION OF WHEAT DURING STORAGE IN THE SIND FOOD DEPARTMENT GODOWNS (1984-85)



Source: Protection of Bagged Grains Stored by Government Agencies in Pakistan, by Hafiz Ahmed, et. al., Grain Storage Research Laboratory, Pakistan Agricultural Research Council, August 1987, p. 15.

PASSCO godowns sampled showed signs of infestation. The situation in PASSCO's outside storage facilities, however, was far worse. Over 70 percent of these facilities were infested by rodents and birds in varying degrees, but it is virtually impossible to keep these pests from feeding on grain stored outdoors.

In the urban markets surveyed, losses to rats ranged from 0.12 to 0.24 percent. In most instances, the rat populations were close to the maximum sustainable number for those area.[14] Of greater concern were the resulting contamination of grain and health risks posed for the surrounding human population.

Loss Projections By Type of Storage. Experience Incorporated, a U.S. consulting firm, inspected the sites for the USAID Godown Rehabilitation Program and subsequently published the loss estimates contained in Table III-2.[15] The lowest losses were recorded in PASSCO's HTG ("house-type" godown) which had an annualized loss rate of 3.2 percent, while the highest annualized loss rate -- 11.5 percent -- was recorded in open storage. The other HTG had a loss rate of more than 7 percent on an annual basis, and Bini shell and bulk facilities suffered a losses of 4.9 percent and 5.1 percent respectively.

PARC/World Bank Loss Assessments. A World Bank survey[16] of post-harvest and storage losses in the public and private sectors is summarized in Table III-3, based on a projected 12.5 million metric tons for the 1984-85 crop year.

It must be noted that, in Table III-3, the respiration loss in public sector storage did not represent a change in the edible portion of the wheat available for consumption. All other losses in the table (i.e. 141,000mt - 13,000mt, or 128,000 mt) represented a disappearance of edible wheat.

If the losses from harvesting, threshing, transport, handling, and respiration, along with 0.5 percent of the quantity in storage are counted as "unavoidable losses", the quantity available for consumption would be reduced by 563,500 metric tons (the total "avoidable losses"). This is equivalent to the annual consumption of 4.3 million persons, assuming an annual per capita consumption rate of 120 kilograms. In the public sector, the "avoidable losses" alone would be 123,000 metric tons or the annual consumption equivalent of over 1 million persons at 120 kilograms per capita.

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[14] Joe Brooks, Ejaz Ahmad, and Iftikhar Hussain, Rat Populations Losses at a Pakistan Grain Market. Tech. Report No. 12, NARC, 1987.

[15] Experience, Inc., Godown Rehabilitation, Recurrent Cost Analysis and Management Audit of Public Sector Grain Storage, November, 1986.

[16] Agroprogress Kienbaum Int. GmbH, and Indus Associated Consultants, Foodgrain Storage and Processing Study, Vol. 1, 1987. pp. 61-66.

Table III-2

ESTIMATED ANNUAL STORAGE LOSS RATES BY TYPE OF STORAGE, ORGANIZATION, AND OWNERSHIP

ITEM	House Type Godowns					
	PFD 1/	Bagged Hired	PASSCO 2/	Bulk	Bini Shell	Open
No. Observations	118	4	12	22	7	6
Wheat Stored, MT	26,665	1,200	2,640	46,851	10,921	534
Storage Months	439	13	6	153	46	15
Ton-Month Storage	125,856	7,800	15,840	358,241	70,469	2,658
Average Storage Months	6.7	4.5	6	7.7	6.5	5
Storage Losses Mt.	1,086.8	35.6	42.2	1,533.2	289.2	25.6
Average Monthly Storage Losses	162.2	7.9	7.0	199.1	44.6	5.1
Estimated Annual Storage Loss MT	1,946.5	94.8	84.5	2,389.4	535.1	61.4
Annualized Loss Rate - Percent	7.3	7 .9	3.2	5.1	4.9	11.5

1/ Type of storage to be rehabilitated
2/ Type of storage with nominal, acceptable loss level.

Source: Calculation from data in Losses in Punjab Sector Storage, 1984-85, Pakistan Agricultural Research Council, 1986. by Experience, Incorporated, Godown Rehabilitation, 1986 L-1.

Table III-3

POST HARVEST LOSSES FOR WHEAT

Level and cause of losses	Quantities involved 1984/85 (1000 mt)	% of losses	Losses (1000 mt)
Farm Level			
harvesting	12,500	2.5	313
threshing/handling/ transport	12,500	1.5	188
Storage:	7,100		
--rodents/birds		1.5	107
--insects		3.5	249
			857
Marketing Agents and private storage			
handling/transport	2,100\		
storage	2,100/	5.0	105
			105
Public Sector			
handling/transport	3,300	0.1	3
storage:			
-wheater (moulds)	1,000	1.0	10
-insects	3,300	3.5	115
-respiration	3,300	0.4	13
			141
Total Loss			1,103

Notes: Quantative estimates based upon the AO/Indus loss-assumption for the 1984/85 crop.

Total loss amounts to 1.103 million metric tons, or 9.0 percent of total crop.

Harvesting and On-Farm Storage Losses. Figure III-2 graphically represents the losses of edible grain as reported in Table III-3. Much of the loss at the farm level occurs at harvest. While harvest and on-farm storage losses are beyond the scope of this report, it should be noted that GRSL and the FAO are conducting

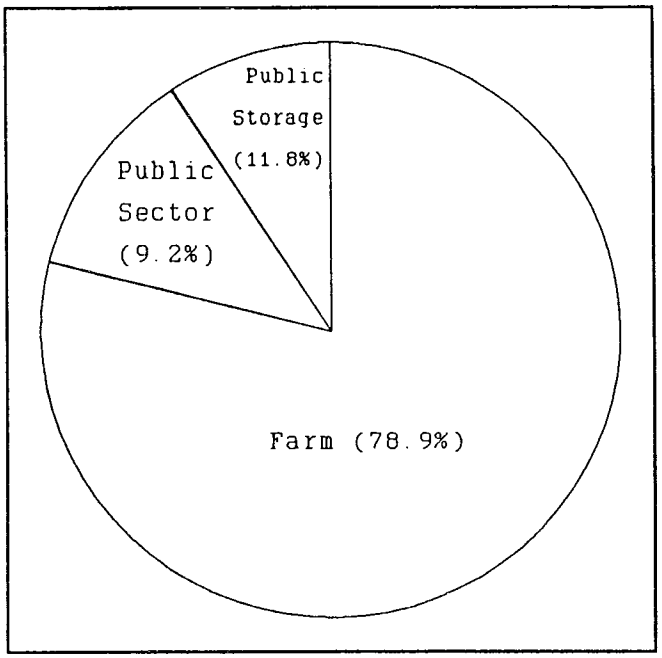
studies to determine ways in which on-farm storage losses can be minimized. As part of this program, GSRL has developed a storage methodology for a sealed polyethylene enclosure and phostoxin fumigation (PEPF).

It is also worth noting that the use of combines has increased yields of wheat by about 14 percent.[17] However, the rapid increase in use of mechanical harvesting and threshing equipment in Pakistan may have contrasting effects on wheat quality. On one hand, mechanical harvesting has reduced the time from wheat maturity to harvest from 28 days to 8 days, reducing losses due to shattering and damage from to adverse weather. On the other hand, because mechanical harvesters work more efficiently and have fewer losses in the field when harvesting at higher moisture content, the moisture content of delivered from fields to the procurement centers may increase. Unless the procurement centers are better equipped to deal with higher moisture wheat, insects, moulds, and heat damage may become more of a problem.

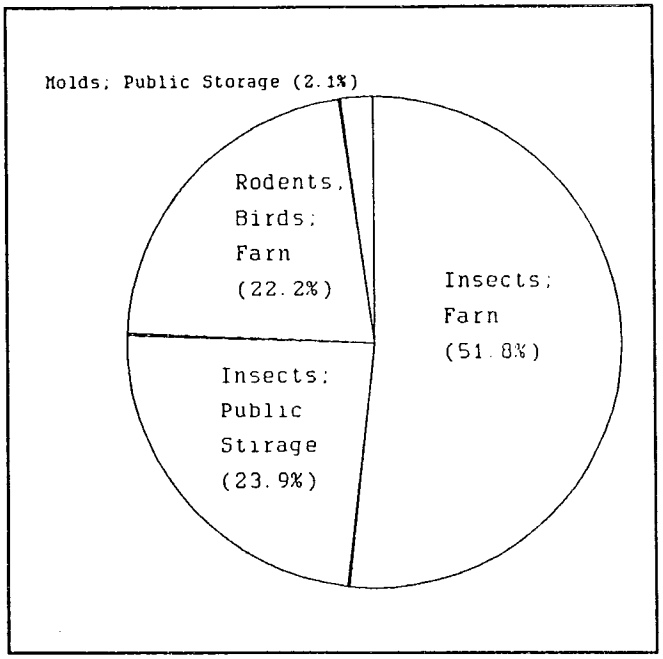
Figure III-2

SOURCES OF VOLUME CHANGES

RELATIVE IMPORTANCE OF EDIBLE LOSSES
ON FARM, PRIVATE SECTOR, PUBLIC SECTOR



SOURCES OF AVOIDABLE LOSSES
PERCENT OF AVOIDABLE FARM, PUBLIC SECTOR LOSSES



[17] Melinda Smale et al., Wheat Harvest Technology in Punjab's Rice Wheat Zone: Combines, Laborers, and the Cost of Harvest Delay, PARC/CIMMYT Paper No. 87-23, 1987, p. 24.

Private Sector Storage Losses. Little is known about grain losses in the private sector. Most private off-farm storage is of a short term nature, thus the losses are believed to be low. Table III-3 gives only a rough indication of private sector losses, insofar as these figures were based on estimates for the public sector. The Vertebrate Pest Management sub-project of the Food Security Management Program is currently researching private sector crop and storage losses to vertebrate pests, as well as losses in public markets at selected cities.

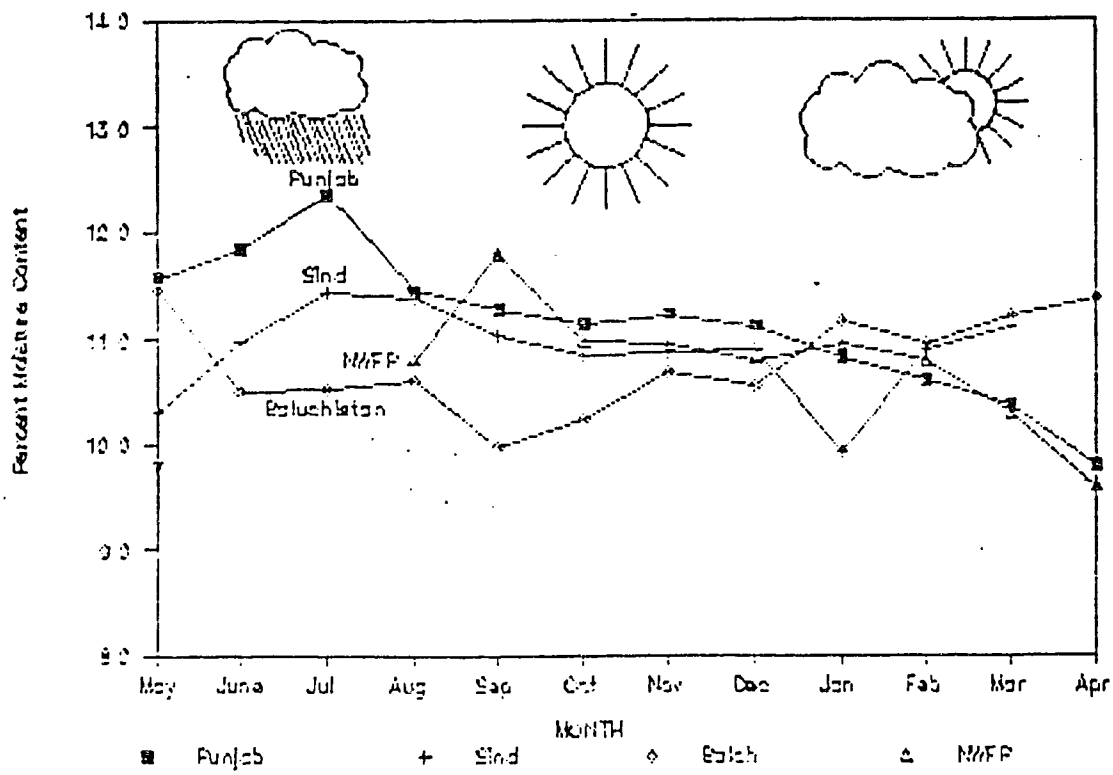
Moisture Changes in Stored Wheat

Pakistan has a favorable climate for the storage of grain. Wheat is generally harvested at a low moisture levels[18] and delivered to procurement centers with a moisture content of 10 percent or less. During long term storage, grains may gain or lose moisture to reach their equilibrium levels, but on the whole, wheat stored with a moisture content less than 10 percent is subject to little gain or loss during the course of the year, given adequate storage facilities.

Figure III-3 is based on moisture content measured by PARC when it conducted grain storage surveys in 1984 and 1985. The moisture fluctuations shown in

Figure III-3

AVERAGE MOISTURE CONTENT OF GRAIN STORED IN 1984-85.



[18] Agricultural Data Collection , FSM, survey of wheat at maturity in the Nabawashawa district, Punjab, reported average moisture content of 11.8% before harvest. Range was 8.3 to 21 percent. In the 1988 Wheat Quality Survey, Chapter IV, moisture content of all wheat surveyed averaged 8.25 percent.

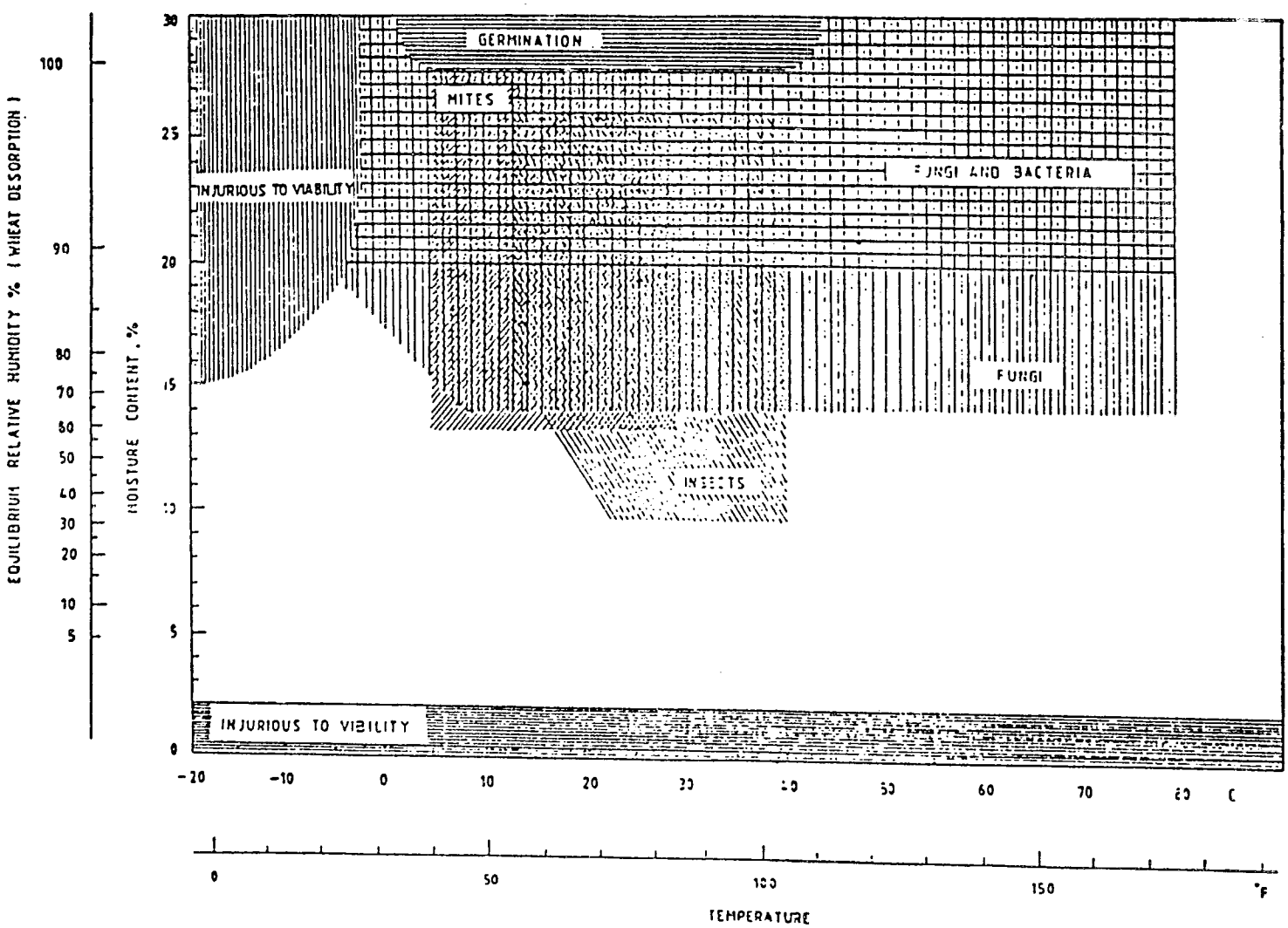
Figure III-3 occurred primarily in the outer bags of wheat (i.e. the ones accessible to the survey team) stacked in the godowns. The moisture content of grains in the interior of the stacks should not change significantly. Where such changes do occur, the causes might be traced to moisture entering the godowns through cracks in the building, to long periods of rainfall and high relative humidity, or to insect infestation.

Safe Storage Conditions for Wheat

Figure III-4 indicates the range of temperatures and humidity within which wheat can be safely stored in Pakistan. Since seed viability is not a factor in the storage of wheat destined for human consumption, the relevant safe ranges are those between eight and ten percent for moisture content and temperatures from 20° C. to 40° C.

Figure III-4

RELATIONSHIP BETWEEN GRAIN MOISTURE CONTENT, TEMPERATURE, EQUILIBRIUM RELATIVE HUMIDITY, AND DEVELOPMENT OF PESTS



Source: Protection of Bagged Grains Stored by Government Agencies in Pakistan, PARC/GSRL, Karachi, August, 1987, p. 8.

The Current Public Grain Handling Storage Management

Technical Annexes III-C, III-D, and III-E contain selections from operating manuals for PASSCO and the Provincial Food Departments. These describe the requirements and procedures for storing grain in government facilities. The instructions are contradictory, stating that "no quality or quantity loss is acceptable" while explaining how to document damage and loss as well as reconcile inventory records when losses occur. In addition, the instructions make it clear that godown employees will be held liable for losses during storage.

Technical Annex III-F summarizes remarks made by farmers, middlemen, flour millers, and godown workers regarding the FAQ procurement system and the No Loss Policy. While the statements themselves reflect individual biases and cannot be statistically confirmed, they reveal the depth of dissatisfaction that exists towards the current system.

GSRL/PARC Report No. 3 attributes the current low standards of grain storage in Pakistan to several factors:

1. Public apathy: Our people accept insect damaged grain as a part of life. This is evident in the famous urdu saying "weevils always get grounded [sic] with the wheat". As such, there is hardly any public pressure on government for preservation of quality in foodgrains under the custody of public bodies. Government as well as public in general are happy as long as food grains are available in sufficient quantities....

2. Ineffective pest control measures and out-dated instructions and know-how: Persons responsible for stock keeping in the public sector do their best... But losses continue to take place. This is primarily due to the outdated recommendations and instructions provided to them. Effectiveness of pesticides changes in the face of changing susceptibility of pests. Other conditions also change with time and the advancement of science. At present, there are, however, no arrangements on a regular basis to up-date the knowledge of the persons concerned with pest control operations nor any arrangements to revise the instructions and recommendations being followed by them.

Recap: Wheat Policies and Wheat Losses

Losses of edible volume in public sector grain stocks caused by insects and vertebrate pests are substantial and affect Pakistan's national economy as well as the nutritional intake of its population. The recorded volume weight loss is in the range of 3.5 percent, however, this figure could easily be doubled if "hidden losses" are taken into account. If the 7 percent figure is applied to the four million tons of wheat purchased, stored and distributed by the national and provincial governments each year (60 to 70 percent total production), then annual losses would be 280,000 metric tons. This is equivalent to the annual wheat consumption of 2.3 million persons.

The next chapter presents the results of a recent survey taken by the PMRI to determine wheat quality in government procurement and storage centers. Based

on hundreds of random samples collected in the Sind and Punjab Provinces, the survey evaluated wheat quality using up to date techniques and laboratory equipment. The results provide a benchmark for assessing the adequacy of the FAQ standards, as well as the overall system of quality control used at government procurement centers.The subsequent chapter examines in detail the FAQ system and the No Loss Policy, as well as the role they play in the deterioration of public sector grain stocks.

SECTION IV

WHEAT QUALITY SURVEY IN THE SIND AND PUNJAB

Overview of the Survey[19]

In April and May 1988, STDT and the Pest Management Research Institute conducted a survey of wheat grain quality in selected areas of the Punjab and Sind Provinces. The primary purpose of the survey was to measure the physical quality characteristics of grain at the farmgate and at government procurement centers during the harvest season. In addition, the survey was to make an independent assessment of wheat purchased by the government, providing a basis for comparison with FAQ standards. Finally, it was to evaluate the qualitative effect of differences in the origin of the grain, methods of threshing, and the manner of procurement (i.e. direct from farmers or through middlemen).

Over 824 useable samples were collected, 458 from Sind and 366 from Punjab. Of these samples, 34 percent came from the farmgate and 66 percent from government procurement centers. Wheat from the procurement centers was further differentiated between that purchased directly from farmers (25 percent) and that purchased through middlemen (75 percent). Also 90 percent of the samples had been mechanically threshed (with locally manufactured threshing machines), while the remainder was split almost evenly between grain threshed by bullocks and that threshed by combine harvesters.

Each sample was analyzed for its foreign matter content, moisture content, hectoliter weight, presence of live and dead insects, and proportion of unthreshed, broken, unlike and insect damaged grains. The findings of the survey are summarized in Figure IV-1 and the following discussion.

Foreign Matter. On average, the sampled grain had a high level of foreign matter[20], with a measured content of 1.25 percent, in contrast to the maximum permissible FAQ level of 1.0 percent.

The Sind samples had a significantly higher percentage of dust compared to the Punjab samples, but dockage (organic matter) content was about the same for each set. The total foreign matter content, particularly dust, was higher in wheat supplied by middlemen than in that purchased directly from farmers. Dockage content, however, did not differ substantially between farmer's or middlemen's wheat either in Sind or Punjab.

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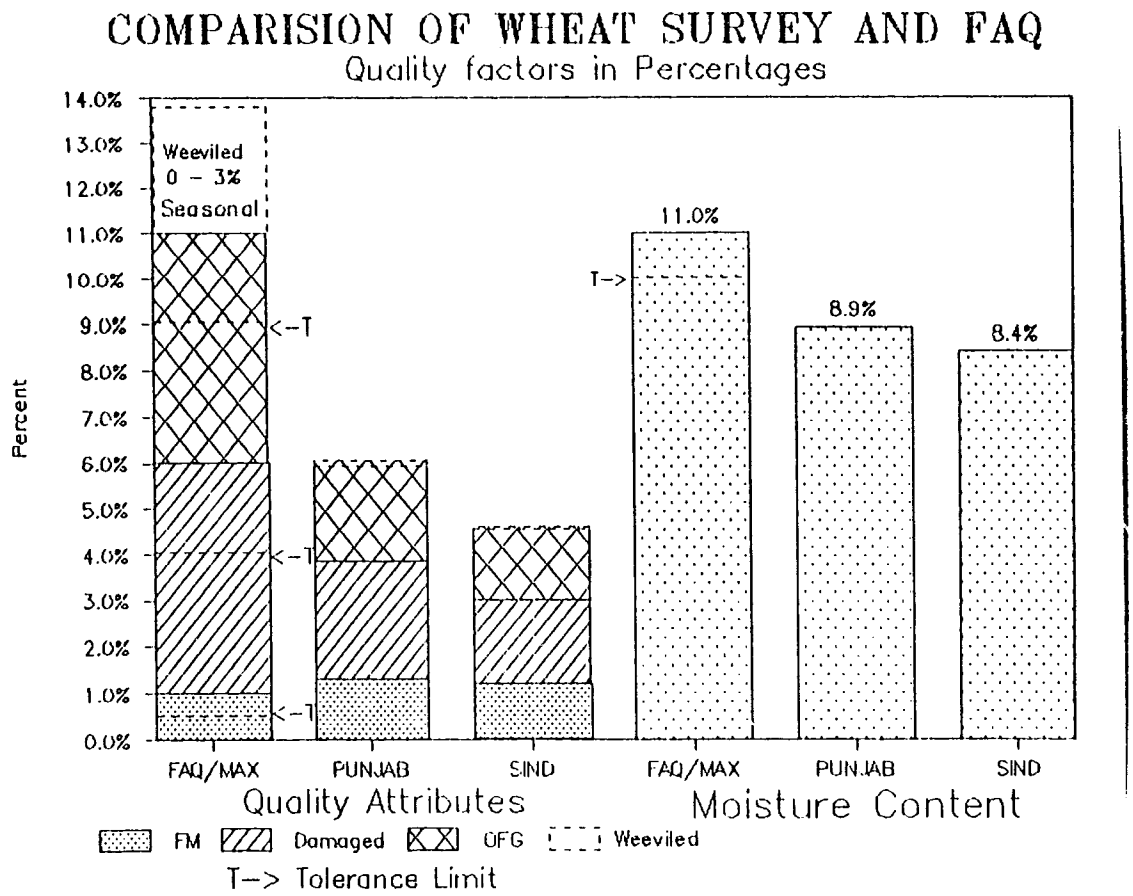
[19] This Chapter summarizes Mubarik Ahmed and others, Physical Quality Characteristics of Wheat at Farmagate and Procurement Centres in Sind and Punjab, 1988. Karachi: Pest Management Research Institute, October, 1988, 63 p.

[20] Foreign matter in wheat consists of dockage and dust. "Dockage" includes straw, weed seeds, and other plant material, as well as insect frass. "Dust" is any inorganic matter, including dirt, dust, sand, and rocks.

Figure IV-1

SUMMARY OF 1988 WHEAT QUALITY SURVEY



The lowest foreign matter content was recorded in the wheat threshed by combine harvesters, while the highest level was in the wheat threshed by bullocks. For all three threshing methods, dockage constituted the major portion of foreign matter. Finally, the samples from Sind procurement centers were found to have less foreign matter than Sind farmgate samples. In the Punjab samples, this was reversed. The foreign matter in both farmgate and procurement center samples, however, consisted more of dockage than dust.

Moisture Content. The overall moisture content of the samples averaged 8.7 percent, in comparison to the 11.0 limit mandated by the FAQ standards. Because of the hot, dry weather typical in Pakistan at harvest time, freshly cut wheat has an unusually low moisture content -- even lower in Sind than in Punjab. When the grain is transferred and then stored at procurement centers, it loses still more moisture, as shown by the lower moisture content recorded in wheat at the centers compared to that at the farmgate. In both provinces, moisture content was higher in wheat delivered by middlemen than that from the farmers. Mechanically threshed wheat had the highest moisture content, followed by wheat threshed with combine harvesters and, lastly, with bullocks.

Hectoliter Weight. Hectoliter weight, or bulk density of grain, reflects a number of variables, including moisture content, foreign matter, extent of insect

damage and the proportion of shrivelled or broken grains. As such it is a useful indicator of overall grain quality. The mean hectoliter weight of 532 samples from both provinces was 77.6 kilograms per hectoliter (kg./hl.), with the average hectoliter weight for the Sind wheat higher than that of the Punjab wheat.

Wheat supplied by middlemen in the Punjab had a slightly higher hectoliter weight than that supplied by farmers. The figures were farmers and middlemen (77.24 kg/hl and 77.42 kg/hl respectively). In the Sind, the mean hectoliter weight of the farmers' wheat was recorded at 80.0 kg/hl, significantly higher than that of the Sind middlemen (78.457 kg/hl).

Broken Grains. Broken grains are an important factor in wheat quality, as they reduce the quantity of wheat actually milled as well as increase the rate of insect infestation during storage.

Samples threshed by combine harvesters had nearly three times as many broken grains as those threshed by other means. For both provinces, wheat supplied by middlemen had more broken grains than wheat purchased directly from farmers. There was, however, no appreciable difference in the number of broken grains among samples from the farmgate versus those from procurement centers.

Unthreshed Grains. "Unthreshed" or partially threshed grains are those which, after threshing, retain outer stalks, seed heads, or other parts of the wheat plant. For all practical purposes, these are damaged grains that should be screened out before milling.

Samples supplied by middlemen showed a slightly higher proportion of unthreshed grains than those supplied by farmers. The mean percentage of unthreshed grains was found to be significantly higher in Sind samples than in Punjab samples.

Unlike Grains. The presence of food grains other than wheat (e.g. barley) diminishes the value of a given quantity of wheat and poses additional insect and mold risks to wheat in storage. The survey found the mean percentage of unlike grain in its samples to be 1.44 percent and composed mainly of barley. No significant difference was detected between samples from Sind and Punjab, although farmgate samples had more non-wheat grains than those from the procurement centers. Wheat supplied by farmers and by middlemen had nearly the same proportions of unlike grain in both provinces. Combined samples, on the other hand, showed a far lower frequency of unlike grains than those threshed mechanically or by bullocks.

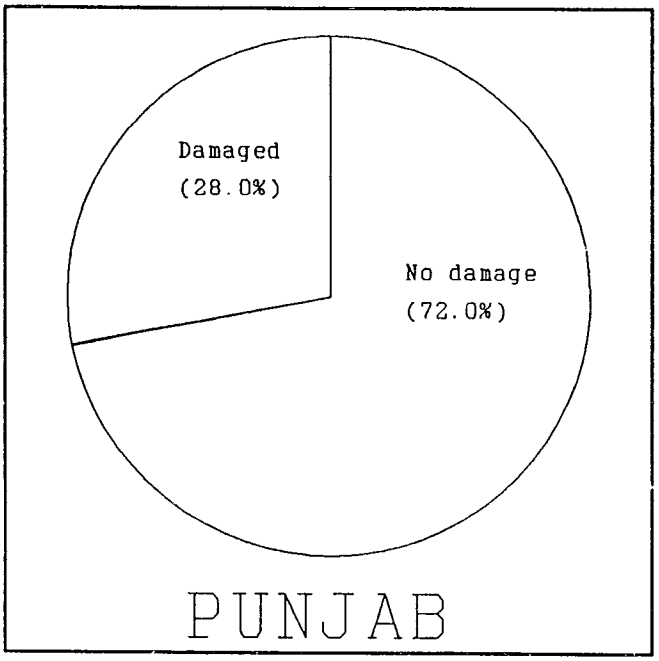
Insect Damaged Grains. Insects play a major role in the deterioration of stored wheat and consequent losses of weight and quality. Freshly harvested wheat generally has neglible levels of insect infestation. Stored product pests enter the grain soon after it is harvested. The problem of stored grain infestation originates more during post-harvest handling than in the field.

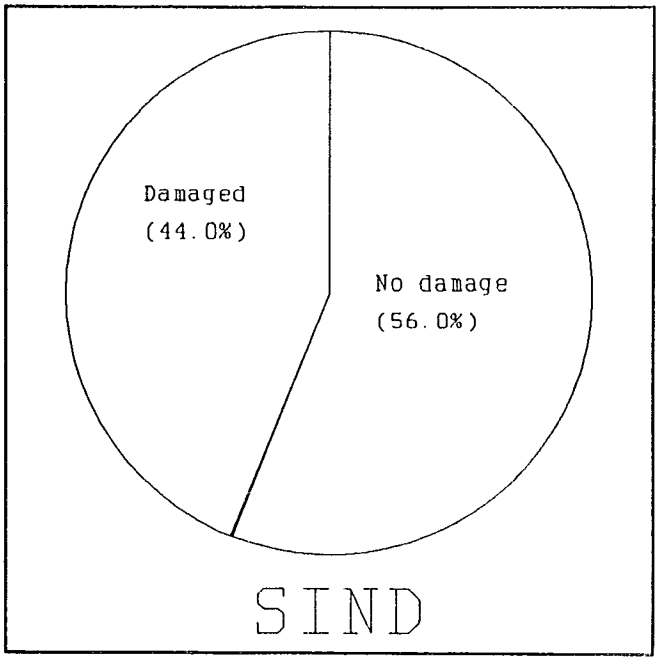
The survey found three common species of stored grain insects among the wheat samples from both the Sind and Punjab, while two additional species were found in the Sind samples. Ninety three percent of the samples were free of live or dead insects in both provinces, although the extent of insect damage in infested samples was higher in the Sind wheat than in the Punjab wheat. (Figure IV-2)

Figure IV-2

SURVEY SAMPLES CONTAINING INSECT DAMAGED KERNELS

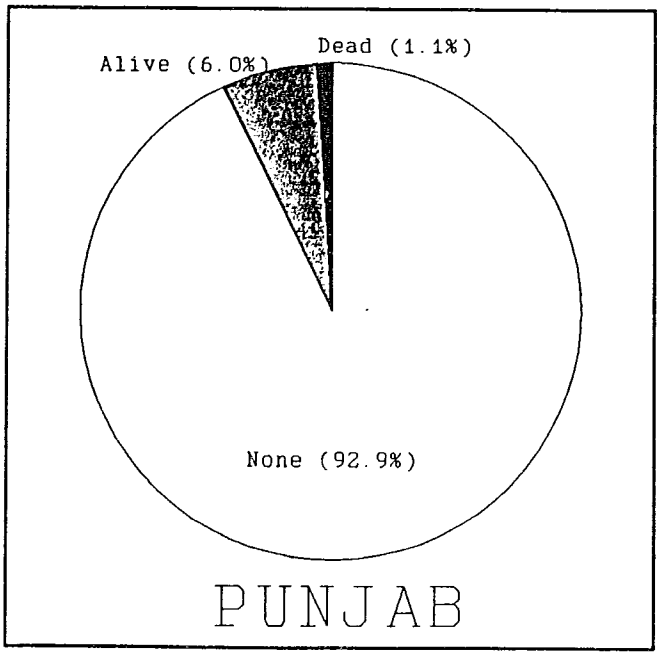
Percent of Samples with Weevil Damaged Grain

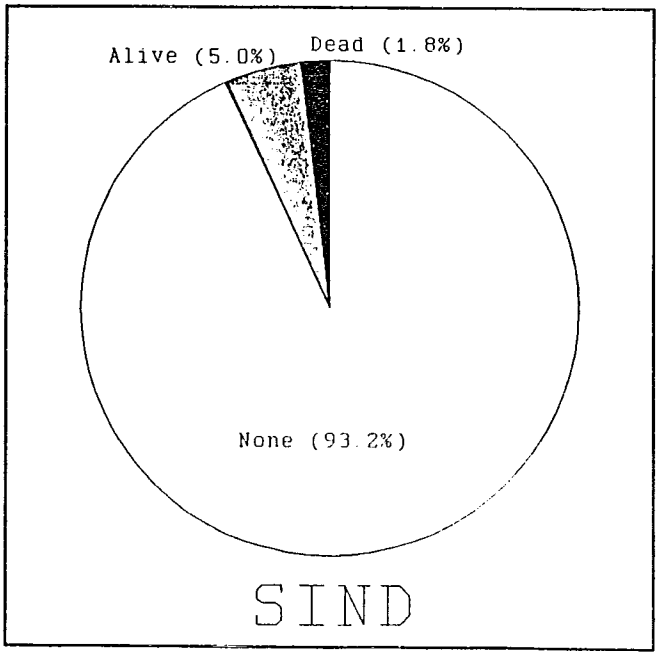




OCCURRENCE OF INSECTS IN SURVEY SAMPLES

Percentage of Samples with Alive, Dead, or No Insects





In the Punjab, insect infestation was greater in the procurement centers than at the farmgate. Samples from both provinces yielded significantly more insect damaged grain from middlemen than from farmers. Samples at the provincial level suggest that the infestation levels between threshing methods are negligible.

Through custom and tradition, the term weevilled is used to describe all kernels exhibiting insect damage. The most noticeable defect is a hole in the kernel. The kernel itself must be split open to determine if insects or larva are present.

Overall Wheat Quality

Wheat samples from the Sind had a higher incidence of foreign matter, as well as more unthreshed, unlike, broken, and insect damaged grains. Sind wheat also showed evidence of more severe insect infestation than Punjab wheat, although the proportion of samples with some insect damage were virtually the same. Given the Sind's comparable levels of insect infestation in wheat at the farmgate and procurement centers, it can be assumed that degradation began at the farm, not just the storage sites. The Punjab samples indicated that infestation began at the procurement centers. This would account for the difference in numbers of insect species between the two provinces.

The quality of the samples varied not only between the provinces but among districts within the same province as well. In the Sind, samples from Larkhana contained the highest levels of foreign matter as well as unusable grains, while the samples from Khairpur had the lowest levels. In Punjab Province, samples from Sargodha, Chakwal, Khanewal,and Vehari had, on average, the highest levels of foreign matter and unusable grains. Islamabad, Okara, Bahawalnagar, Rawalpindi, and Rahim Yar Khan had low levels of unusable materials.

Wheat at the government procurement centers was only marginally better than that at the farmgate, except with regard to insect infestation. Moreover, wheat supplied by middlemen did not match the quality of wheat obtained directly from farmers. The different methods of threshing each had their own merits and disadvantages for wheat quality. Wheat threshed by bullocks had higher amounts of foreign matter, unthreshed and unlike grains but lower proportions of broken grains and moisture content. Wheat threshed by combine harvesters had opposite characteristics. Mechanically threshed wheat was found to lie in between, with intermediate levels of foreign matter, moisture, and unusable grains.

FAQ and Measured Grain Quality

As shown in Figure IV-1, there was considerable variation between the observed quality of the samples and the "Fair Average Quality" procurement standards for wheat. A majority of the samples slightly exceeded acceptable FAQ limits for foreign matter using Punjab and PASSCO standards. Nearly all samples were below the Sind standard of 2 percent. The average moisture content and proportion of unlike grains in the survey were less than the FAQ standards.

Previous surveys of wheat quality have found a similar disparity between FAQ standards and measured grain quality. A GSRL survey in 1983, indicated that all of wheat should have been rejected if FAQ standards were rigorously applied. The 1983 harvest season was unfavorable due to rains. The PARC surveys of

1984/85, had similar results. In their surveys, a substantial portion of the wheat supplied to procurement centers as well as that delivered to end users failed to meet FAQ specifications. (Technical Annexes IV-A and IV-B)

In summary, the present FAQ standards do not describe the wheat that is being produced. Nearly all wheat sampled in the 1988 survey was much better than the FAQ specifications.

Section V

EFFECTS OF FAQ AND NO LOSS POLICIES ON WHEAT SUPPLIES

Application of the FAQ Standards and No Loss Policy

While the concept of "Fair Average Quality" is sound, its present application in Pakistan is seriously flawed. Provincial rules and regulations prohibit taking samples from wheat offered by producers. Wheat offered by middlemen can be sampled, but middlemen are paid in full on delivery. The provincial food department employee responsible for accepting substandard wheat must get a refund of the overpayment if a laboratory analysis later indicates that the wheat substandard. No instance of a recovery for defective wheat has ever been recorded.

Supervision of wheat storage and distribution in the provincial food department is the responsibility of political appointees and civil service administrators. PASSCO has developed a more stable and professionally oriented staff. With a rapid turnover of personnel who lack technical expertise in grain storage, the NLP policy remains a simple and easily understood administrative tool. However, as the volume of activity has increased and storage times lengthened, the NLP tends to mask the true condition of grain stocks, and forces end-users to accept lower quality wheat at FAQ standard prices.

Interaction between FAQ and the NLP

Current procurement regulations require the FAQ standards to be applied before the Provincial Food Departments or PASSCO can accept wheat tendered to them. Once the wheat has been accepted and placed in storage, the No Loss Policy comes into effect. Accordingly, no provision exists for subsequent adjustments in the wheat volume (weight) to reflect changes in moisture content, losses during handling, and damage from insects, moulds, and other pests. Figure V-1 schematically depicts the operational impact of these policies.

The root of the FAQ problem is the lack of objective tests and measures to enforce even the present quality standards. Furthermore, the technical terms and methodology for applying the FAQ standards have never been fully defined or adequately documented. Researchers preparing the recent World Bank study of wheat quality in Pakistan, for example, developed their own grades and classifications based on their own interpretation of FAQ. (Technical Annex V-A)

From the outset, the FAQ has had as many interpretations as there have been persons employed to apply them. The wide discretion conferred on the buying personnel only increases the likelihood of irregularities in the buying processes. The power to discriminate among sellers, coupled with personal responsibility for maintaining volume despite unavoidable losses, neither imposes discipline on grain storage employees nor ensures that quality will be the foremost consideration in the buying, storage, or release of wheat.

Figure V-1

RELATIONSHIP BETWEEN THE FAQ AND NO LOSS POLICY

AND IMPACT ON DISTRIBUTION AND CONSUMPTION

Procurement under FAQ Operational Impact		Storage under NLP Operational Impact		Distribution and Consumption Operational Impact
No objective test or measurements for moisture, impurities and other factors.	---->>	No record of quality and means for determining change in inventory quality	---->>	Uncertainty as to milling yields and quality of wheat based products.
Purchase of grain with excess foreign material, moisture, insect infestation, broken, and other food grains.	---->>	Increases possibility of inventory deterioration from damage by stored product pests.	---->>	Increases losses in cleaning, processing, and reduced quantity yields of products to sell.
Opportunity for fraud, corruption, mistreatment of producers, collusion with middlemen.	---->>	Quality losses not detectable, additional costs for storing and transporting excess foreign materials.	---->>	Higher costs, lower product quality, higher consumer prices.
Some producers and middlemen add foreign material to offset losses to malpractice in procurement.	<---- ---->>	Workers may underweigh and/or add FM to offset weight loss in storage and avoid liability for volume loss.	---->>	Reduced food supply, lower caloric intake, health hazards for consumers.
Income reduced to producers who do not adulterate grains or are unable to sell to centers.	<---- ---->>	No incentive to purchase better quality	---->>	Lower nutritional benefit for consumer.

The lack of objective testing permits the purchase of wheat with excess moisture, foreign matter, broken grains, insect damage, and other attributes which reduce its quality. Once the wheat enters the system, no references are made to quality factors in official records. Excess foreign matter and moisture creates an environment favorable for development of insects and moulds, opening the way for further reductions in the volume and quality of stored wheat.

To offset the inventory shrinkage, procurement personnel may try to underweigh the wheat at the time of purchase or obtain extra wheat from the sellers without payment.[21] With this in mind, sellers can protect themselves by adding excess moisture or foreign matter to their grain. Producers or middlemen who do not similarly adulterate their grain suffer a direct loss of income.

Shifting the Impact of the FAQ and NLP

The cumulative burden of problems created by the FAQ standards and the No Loss Policy are borne by private sector distributors, processors, and consumers, along with the Federal Government, which subsidizes wheat storage and distribution. In many instances, the direct costs are hidden but eventually show up in the form of higher grain cleaning costs, reduced mill output, lower quality flour, and ultimately the loss of nutritional value.

The following scenario, outlined in Table V-1, illustrates how the burden is shifted through the marketing chain. At the procurement center, the producer or middleman sells wheat that exceeds the FAQ limits for moisture content and foreign matter in order to offset an anticipated underweighing. The wheat is accepted as FAQ and the producer is paid Rps. 200.00 per hundred kilogram sack, but the procurement center actually receives 102 kilograms in each sack due to a "fault" in the scale. Later, inside the procurement center, the sacks are standardized to 100 kilograms each and then transferred to a central godown. After a period of months, the procurement center ships to the flour mill exactly the quantity recorded at the time of purchase. The procurement center records indicate that the few sacks left over after standardization were bought from a local middleman.

The wheat may be stored for 6 months before it is delivered to a flour mill. In storage, it loses weight for four months until a 9.5 percent equilibrium moisture content is reached. After the fourth month, insects multiply rapidly and damage 10 percent of the kernels. The insect activity adds about 0.5 percent moisture to the wheat, while the weight of the live and dead insects, along with additional dust, offsets some of the weight lost by consumption of the endosperm. When the wheat finally reaches the flour mill, it has a 10 percent moisture content, and 3.5 percent impurities.

Figure V-2 is a graphic representation of this scenario. The black area depicts the maximum foreign matter content under the FAQ policy. The cross-hatched area is the added foreign material -- most of it the result of insect activity and rebagging of spillage. While each sack of grain may weigh the same as it did when it was purchased from the producer, its composition has changed during handling and storage. Consequently, the mill incurs the cost of the excess foreign material which cannot be made into flour, and this is passed on to the consumer.

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[21] The karda deductions for foreign matter without testing was institutionalized by the private sector in the colonial era. See Technical Annex I-L.

Table V-1

COST OF WHEAT FOR PROCESSING UNDER FAQ STANDARDS AND WITH ADDED FOREIGN MATERIAL AND INSECT DAMAGE

Specification	1988 FAQ Limits: Tolerance -,=,+ to	1988 FAQ Limits: Reject over	Wheat Accepted As FAQ	Release to Flour Mill 6 mo. Storage
Moisture Content	10.0%	11.0%	12.00%	10.0%
Foreign Matter	0.5%	1.0%	2.00%	3.5%
Other Food Grains	3.0%	5.0%	5.00%	5.0%
Damaged/shrivelled	3.0%	5.0%	5.00%	5.0%
Weeviled 1/	0.0%	0.0%	1.00%	10.0%
Wheat Content/kg 2/	96.5	93.0	91.5	91.5
"Hidden Loss" 3/			0.25	2.5
Actual Wheat Content/Kg.	96.5	93.0	91.3	89.0
Price Rp/100 Kg	200.00	200.00	200.00	210.00
Actual Cost of Wheat Rp/100 kg.	207.25	215.16	219.18	235.96

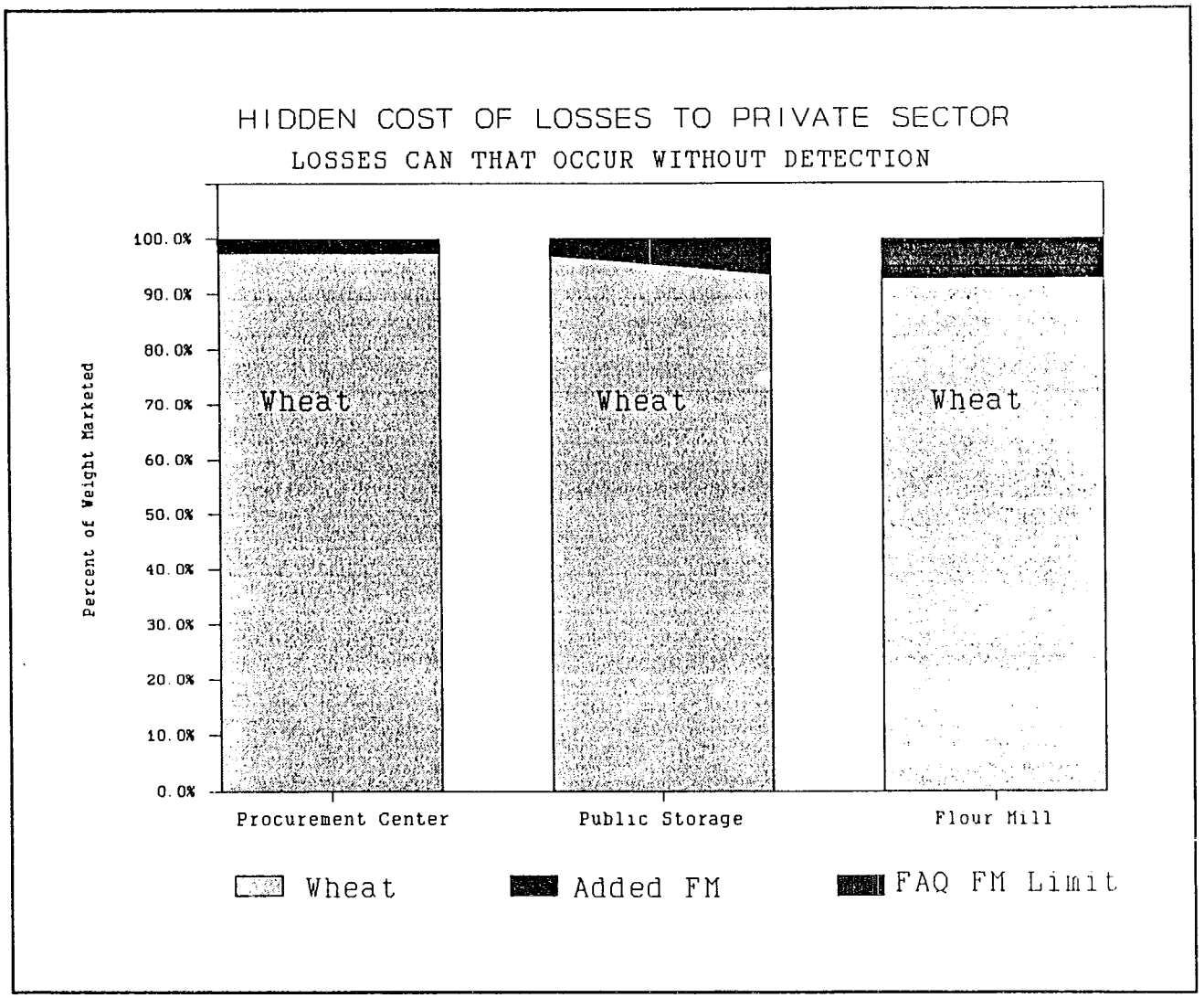
1/ Weeviled wheat accepted after August
2/ @ 10.0 % MC, foreign matter, other food grains removed.
3/ Weeviled percent x 25%

If the FAQ had been strictly observed, the actual cost of the usable wheat (i.e. after removing the allowable foreign material) would have been, at the lowest limit, equivalent to Rps. 207.25 per hundred kg. or, at the maximum permissible limit, Rps. 215.16 per hundred kg. In this scenario, however, the FAQ was exceeded due to a subjective "error" in evaluation, hence the cost of wheat actually received was Rps. 219.18 per hundred kg.

According to the scenario, a flour mill would expect to have 91.3 kilograms of usable grain per sack after cleaning and the removal of impurities. However, hidden losses will reduce the amount available for milling to 89.0 kilograms. While the flour mill paid Rps. 210 per sack, the net cost of the useable wheat is Rps. 235 per sack. Some recovery from selling broken wheat, other food grains, and dockage as animal feeds is possible, but on a per kilogram basis, the value of "screening" is usually less than the amount paid.

Figure V-2

HIDDEN COST OF LOSSES TO THE PRIVATE SECTOR



Impact of FAQ on Producers. The present "fair average quality" system is not necessarily fair in that producers are not paid uniformly for the value of usable wheat. Sellers who are not penalized for delivering grain with moisture and foreign matter content greater than the FAQ maximum are overpaid. On the other hand, sellers who deliver wheat with a low moisture content and foreign matter below FAQ specifications are underpaid.

Table V-2 illustrates the inequities which currently exist in the FAQ procurement system. For example, if three wheat producers each deliver one metric ton of wheat with varying quality characteristics and the buying price is Rps. 2000 per ton (based upon a standard of 1 percent foreign matter and 10 percent maximum

moisture content), then each lot should be priced differently according to its quality. However, under the typical FAQ inspection, the procurement center accepts all the grain "as is" and pays each producer the posted price of Rps. 2000 per ton.

Table V-2

INEQUITIES IN FAQ PAYMENTS

Producer	Foreign Matter Percent	Humidity Percent	Usable Wheat (Kg.)	Over (under) Payment
A	4.0	12.0	948.1	103.80
B	1.0	10.0	1,000.0	0.00
C	1.0	8.0	1,022.2	(44.40)

Source: Own calculations

The relative value of each lot can be determined from the tables shown in Technical Annex V-A. Producer A's wheat contains 30 kilograms of excess foreign matter and 21 kilograms of excess moisture when dried to the 10 percent content required by the FAQ standard. In effect, producer A was paid for 51.9 kilograms of excess moisture and impurities at the rate of Rps. 2.00 per kg. or a total of Rps. 103.80.

Producer B's wheat matches the specifications precisely, so the procurement center receives 1,000 kilograms of usable wheat (including the allowable 10 kg. of impurities). Producer B neither gained nor lost according to the specifications but did lose relative to producer A who, in effect, obtained an "unearned" profit.

Producer C lost relative to both A and B. 1000 kilograms of the low moisture wheat would weigh 1022 kilograms if the grain had the 10 percent moisture content allowed by FAQ. Hence, the procurement center gained 22 kilograms of wheat free from Producer C.

Purchasing wheat on the basis of objective tests requires the equipment and techniques for precise measurements of weight, moisture content, and impurities. Once procurement decisions are made according to the results of random testing and grading by skilled technicians, the credibility of the system can be improved among wheat producers and marketing agents.

Impact on Consumers. Ultimately, it is the consumer who bears the brunt of post-harvest losses, through reduced supplies, lower quality flour, and higher

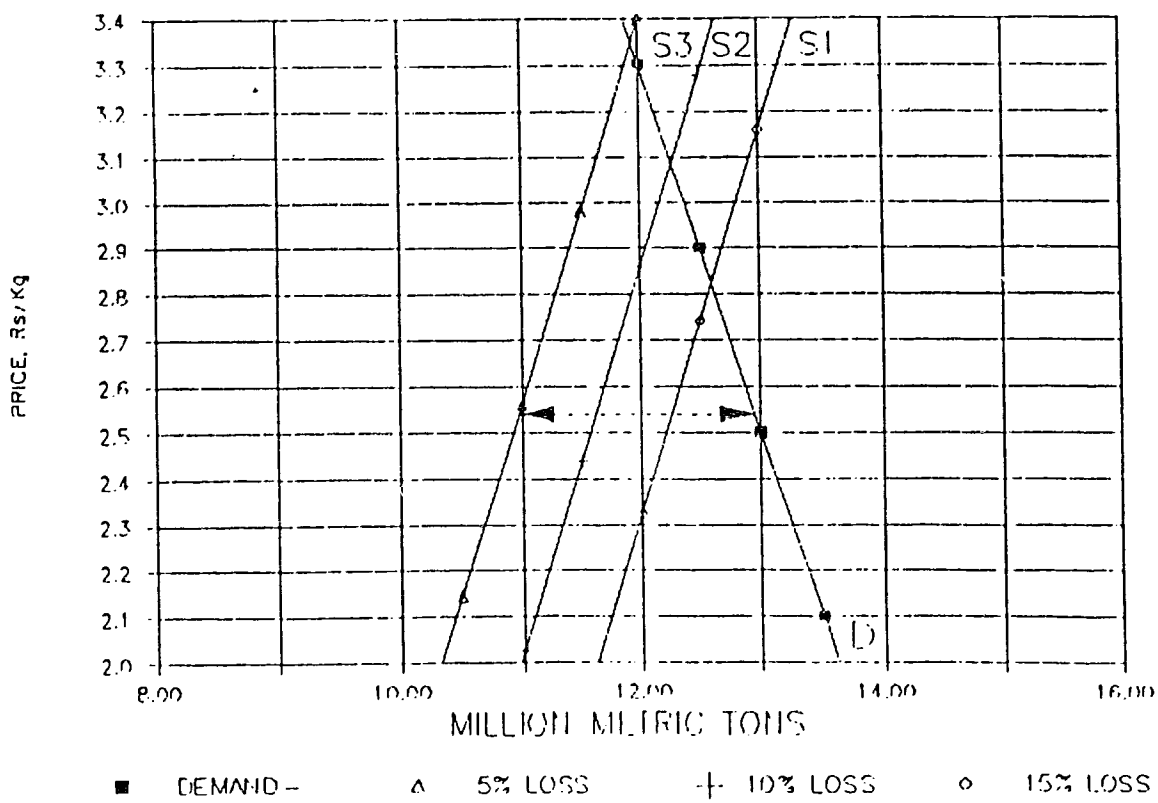
prices. The flour itself frequently has a poor taste and, more important, its nutritional value is lower.

Estimates of increased consumer costs due to post-harvest losses can be made by charting the relationship between retail prices and reduced supplies in the market. This is shown in Figure V-3 and indicates that a ten per cent reduction in the present wheat supply (without consideration for quality or nutritional content), would increase prices by nearly 25 percent. The reverse is also possible, that is, if market supplies increased after eliminating a 10 percent post-harvest loss, consumer prices would drop by ???? percent.

The supply and demand curves in Figure V-3 represent approximations of the market situation in Pakistan since the government abandoned its "partial provisioning system" subsidy in March 1987. The consumer demand curve "D" intersects the supply curve "S-2" (total production minus 10 percent), yielding a market equilibrium price of about Rps. 3.10 per kilogram of wheat. The "S-3" curve represents the total wheat supply minus 15 percent post-harvest losses. The losses, as shown by the supply curve, increase consumer prices to over Rps 3.30 per kilogram. If losses are cut to 5 percent, the supply curve shifts to the right and the price drops to about Rps. 2.80 per kilogram. If consumer prices were fixed at Rps. 2.50 per kilogram of wheat, a gap would appear between the amount in demand and that which producers would be willing to sell. This is shown in Figure V-3 by the arrow between the supply and demand curves at the Rps. 2.50 level.

Figure V-3

EFFECT OF GRAIN LOSSES ON CONSUMER PRICES



Source: Unpublished data, Economic Analysis Network, Food Security Management Project, Islamabad

Impact on the Government. The cost to the government of receiving, handling, storing, and distributing excess foreign matter in wheat can be tracked from the farmgate to the flour mill. The respective steps in the process include the procurement centers; rural storage areas such as reservoirs, godowns, and silos; railway depots and carriages; urban storage areas; holding areas at the flour mills; and, of course, truck or animal transport between all of these points.

Table V-3 shows the estimated costs (in 1983-84 Rupees) for this entire process, including the variable costs associated with packing (in sacks), handling, financing and other requirements. Total variable costs amount to Rs. 675.30 per metric ton.[22] Storage costs for two months' carry-over stock come to Rs. 405 per metric ton annually. Finally, the procurement cost of the wheat is Rs. 1,750 per metric ton, which reflects the prevailing price during the 1983-84 crop year. No fixed costs are included in the calculations.

Given the total procurement level of the provincial and federal governments, a 2 percent excess of foreign material over the 1 percent FAQ maximum would have yielded a total of 94,000 metric tons of foreign matter to be handled, stored, and transported during 1985-86. At 3 percent, this excess foreign matter would have come to about 141,000 metric tons. To put it another way, these quantities would have filled 85 and 128 standard godowns, respectively, with inert material. Assuming that this material was stored in 100 kg. sacks costing Rs. 15 each, the excess foreign material would have required Rs. 14.7 and 22.08 million for sacks.

At the combined provincial and federal government procurement levels for 1984/85 and 1985/86, an excess foreign material content of 2 percent above the 1 percent procurement limit implied a total annual cost of Rs. 543 million and Rs. 293 million respectively just to receive, handle, store, transport and distribute foreign matter. The opportunity cost of the existing Fair Average Quality and No Loss Policy should be clear, assuming no change in these policies, an average cost of Rs. 300 million per year for an excess foreign material of 2 percent above the procurement limit of 1 percent would add up to Rs. 3.6 billion by the year 2000.

Recap: Combined Effects of the FAQ and NLP

The lack of quality control under the FAQ system and the No Loss Policy has created opportunities for malpractices in the government wheat procurement and distribution chain. The major suppliers of wheat to government procurement centers are now primarily large producers who are increasingly mechanized and influential. Small farmers sell to "arthis" or wholesale middlemen who, in turn, sell to the government. Because no objective inspection system exists, application of the FAQ standards has become a matter of personal judgment, bargaining, and/or economic and political persuasion. The lax enforcement of the present minimal standards has, moreover, created skepticism and mistrust among those outside the public sector and complacency within.

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[22] Agricultural Prices Commission, Report of the Working Group to Examine and Suggest Economies in the Distribution Cost of Wheat. Islamabad, April, 1985.

Once wheat is accepted and placed in storage, the No Loss Policy discourages measures to preserve quality. Consequently, grain in public storage accumulates additional foreign matter, and its quality declines. The problems of grain loss and declining quality are not, in any case, resolved within the procurement and storage network but instead shifted to the next link in the distribution chain -- usually the flour mill. In the end, consumers, particularly those in low income brackets, suffer the consequences of the FAQ system and No Loss Policy, as they must pay higher prices for a lower quality product.

Table V-3

VOLUMES AND COSTS ASSOCIATED WITH RECEIVING, HANDLING, STORING AND DISTRIBUTING EXCESS FOREIGN MATERIAL

		Excess Foreign Material Above 1% F.A.Q. (mt)			Costs for Excess Foreign Material Above 1% F.A.Q. (Million Rs.)		
Year	Total	at 1%	at 2%	at 3%	at 1%	at 2%	at 3%
1984/85	4,707.3	47,073	94,146	141,219	428,731	542,898	657,064
1985/86	2,542.0	25,420	50,840	76,260	231,520	293,171	354,823
1990	6,153.36	61,534	123,067	184,601	560,436	709,673	858,911
2000	3,165.89	31,659	63,318	94,977	288,343	365,125	441,908

Sources: 1984/85 - 1985/86 from Foodgrain Storage and Processing Study Annex 3.6.1, page 5, Agroprogress Kienbaum, Bonn West Germany

1990 and 2000 are Projected volume of purchases under Scenario 2 which assumes the elimination of the ration system, Annex 3.4.2, pages 17, 22.

Costs are given in 1984 Rupees as per "Report of the Working Group to Examine and Suggest Economics in the Distribution Cost of Wheat Agricultural Prices Commission, April 1985, as follows:

1. Incidentals of Rs. 675.35 per ton, page 7.
2. Cost of carry over stock of Rs. 405 per ton, Annexure G.
3. Procurement price of wheat of Rs. 1,750 per ton, page 2.

Two months of carry over stock are assumed.

Section VI

CONCLUSIONS AND RECOMMENDATIONS

Measures to Change the FAQ and No Loss Policy

With the current trend towards reducing the government role in the economy, changes in the marketing of wheat have already occurred. Discontinuation of the partial provisioning ration system has made the trade in wheat and flour more open and competitive. Some flour mills now bypass the government distribution network and obtain their total wheat requirements from private sources.

Budgetary constraints and the need to reduce public sector spending have prompted the government to seek a greater private sector role in the storage and distribution of wheat. However, to secure private sector participation, changes in existing policies are needed. Essentially this means (1) the introduction of a standardized wheat grading system and routine laboratory testing of wheat stocks, (2) an overhaul of the storage network and its managerial guidelines and practices, and (3) changes in pricing policies to reflect quality differenals. These improvements, outlined in detail in Figure VI-1, will not only reduce costs for the government and consumers alike, they will assure virtually every citizen of better quality wheat and wheat products.

The present concept of "Fair Average Quality" must be refined and adopted as the basis of a nationwide wheat grading system. Similarly, a quality-adjusted scale of buying and selling prices should be introduced to encourage the production and sale of higher quality wheat, as well as to penalize those who abuse the system. As the markets become more knowledgeable and competitive, further price differentials can be introduced to value specific grain attributes according to end use (e.g. premiums for protein levels that exceed a minimum level).

On the other hand, revisions of the No Loss Policy or replacing it with a system of "allowable losses", cannot occur until a more efficient storage and quality control system is in place. Abolishing the No Loss Policy before then would only make quality control more difficult and remove one of the few existing constraints to the malpractices now plaguing public sector storage facilities.

Once a new system has been designed and implemented, its benefits (e.g. reduced expenses and simplified administrative procedures) will far outweigh its costs. A nucleus of required technical expertise does exist with Pakistan. The primary task is to organize the required combination of administrative, technical, social, and economic expertise in a manner that result in the formulation and implementation of effective policies.

STDT and GSRL recommendations, including (1) technical revisions of the FAQ, (2) training needs, (3) grading equipment and (4) budgetary guidelines are contained in Technical Annexes VI-A, VI-B, and VI-C. The basic steps required to improve the public sector quality control and storage systems are summerized below.

Figure VI-1

EXISTING PROBLEMS AND REQUIRED IMPROVEMENTS INCLUDING CONCEPT AND APPROACH

Stage of Operation	Existing Problems	Required Improvement	Concept of Improvement	Approach to Improvement
Procurement	a. Wheat entering system does not meet FAQ standards	a. Objective application of buying standards	a. Modify, improve existing system	a. Research product qualit at harvested
	b. Present system is not equitable for producers	b. Provide producer incentives to improve quality. Buy on basis of quality and quantity delivered	b. Determine producer capability, set specifications accordingly	b. Specify set of quality attributes and methods of measurement
	c. Procurement center personnel engage in undesirable procurement practices	c. Rules and procedures personnel can follow, incentives for good performance	c. Develop rational and enforcible standards for procurement	c. Improve, standardize FAQ by using objective measurements and testing methods
			d. Buy from producers on basis of standardize commodities delivered, according to attainable objective measurements	d. Secure sampling and testing equipment, train personnel in use. Improve supervision and management methods
				e. Demonstrate, convince producers of benefit of change
Storage	a. Losses in quantity and quality from poor storage conditions and management practices.	a. Improved handling and storage practices, objective measurements of quantity, quality changes	a. Changes to be made on objective research and economic analysis	a. Research losses during handling and storage
	b. No means for determining sources, size of losses.	b. Management systems that improve storage practices, reduce costs.	b. Develop rational and enforceable standards for handling, storage and inventory control	b. Specify sound quality, quantity adjustments for objective handling storage, and inventory management
	c. No incentives for personnel to maintain quality.		c. Handle and store grain according to scientific and practical procedures	c. Provide equipment, training, supervision, personnel incentives to improve grain handling and storage practices
				d. Demonstrate to producers public officials, private sector, consumers benefits of new system
Distribution	a. Unpredictable quality at dispatch	a. Delivery of assured quality to buyers	a. Create demand for better quality, sell on quality basis	a. Document cost/benefits for change, create consensus for change by education, publicity
	b. Costs of low quality, high foreign material content shifted to millers, consumers	b. Pricing according to quality attributes	b. Improve quality control in distribution.	b. Develop alternative that can be adopted and implemented
	c. Low quality products, low nutritional benefit for consumers	c. Poor quality keeping characteristics of flour products.		c. Introduce buying by specification with premium and discounts from a base price for a standa

It must be emphasized that these recommendations will require research, evaluation, and trials under operating conditions before they can be adopted as firm policy guidelines. Even then, the anticipated changes will occur in an evolutionary manner through research efforts, shifts in production and marketing patterns, and changes in consumer preferences.

Actions Required by the Government of Pakistan

1. Establish a national grain inspection and grading system based upon revised FAQ standards.

2. Require objective evaluations of the quality of all wheat procured with government funds.

3. Instruct all government institutions (e.g. armed forces, hospital, schools, etc.) to purchase only wheat that meets the national standards.

4. Require all inter-provincial transfers of wheat subsidized by national funds to be made on basis of national wheat standards and all shipments be inspected at points of origin and final delivery.

5. Establish a wheat section within the agricultural policy unit now being established under the Economic Analysis sub-project of the Food Security Management Program.

6. Encourage nationwide producers' and millers' associations to determine quality attributes to be used in buying and selling grain, and methods of payment for quality differentials.

Actions required by Provincial Food Departments

1. Develop operating procedures and management guidelines to implement revised FAQ standards and to replace the No Loss Policy.

2. Establish a grain quality auditing unit in each PFD which reports only to the PFD Director or Deputy Director.

3. Establish accounting systems and regulations which document wheat quality as well as quantity. These should include:

   (a) standardized methods to adjust for moisture content and other losses.

   (b) performance standards for inventory management.

   (c) personnel policies which will reinforce objective purchase standards.

(d) training administrative and technical personnel in the use of quality standards and accounting

4. Conduct publicity campaigns to inform producers of requirements for selling under the revised FAQ grade standards.

5. Phase out or reduce the number of government procurement centers while encouraging private enterprise to conduct the grain trade by:

   (a) licensing private traders or cooperatives as local purchasing agents.

   (b) training in objective grading methods.

   (c) developing specifications for grain grading equipment that can be locally manufactured.

   (d) enforcing strict quality control procedures for wheat traded by local agents and penalizing or revoking licenses for non-compliance.

   (e) encouraging bulk handling and volume grain trading on basis of grade specifications.

A prerequisite for effective wheat policy is a clear specification of the objectives of reform in grain procurement and storage policies.

The Storage Technology Development and Transfer (STDT) sub-project of the Food Security Management Project and the Grain Storage Research Institute offers the following as a means of opening dialogue on policy changes.

Actions Required by STDT AND GSRL

1st Quarter, 1989:

1. Conduct informal meetings and share this report with concerned officials of MINFA, Finance, Planning, PASSCO, Provincial Food Departments, and USAID.

2. Prepare audio/visual presentations on main topics, conclusions, and recommendations from this report.

3. Monitor quality of grains being received and transferred in and out of godowns as part of STDT training and research program.

4. Train PASSCO and Provincial Food Department personnel in grain grading and inspection. This will be continued through life of current training program.

5. Circulate the Technical Recommendations for Pakistan Wheat Grading and Testing Procedures, prepared by the GRSL.

2nd Quarter, 1989:

1. Repeat wheat quality survey on limited scale (100 and 150 observations in Sind and Punjab respectively) to confirm results of 1988 survey and determine "FAQ" for 1989.

2. Test the GSRL recommendations for objective measurements of wheat quality in at procurement centers in conjunction with bulk handling research.

3. Test changes in accounting procedures and management practices at the bulk storage research sites.

3rd Quarter, 1989:

1. Evaluate results of wheat quality survey and grain grading at the procurement centers.

2. Develop training and management courses for middle and upper level management in grain accounting, quality control, and related subjects.

3. Conduct seminars and meetings for flour millers on grain quality.

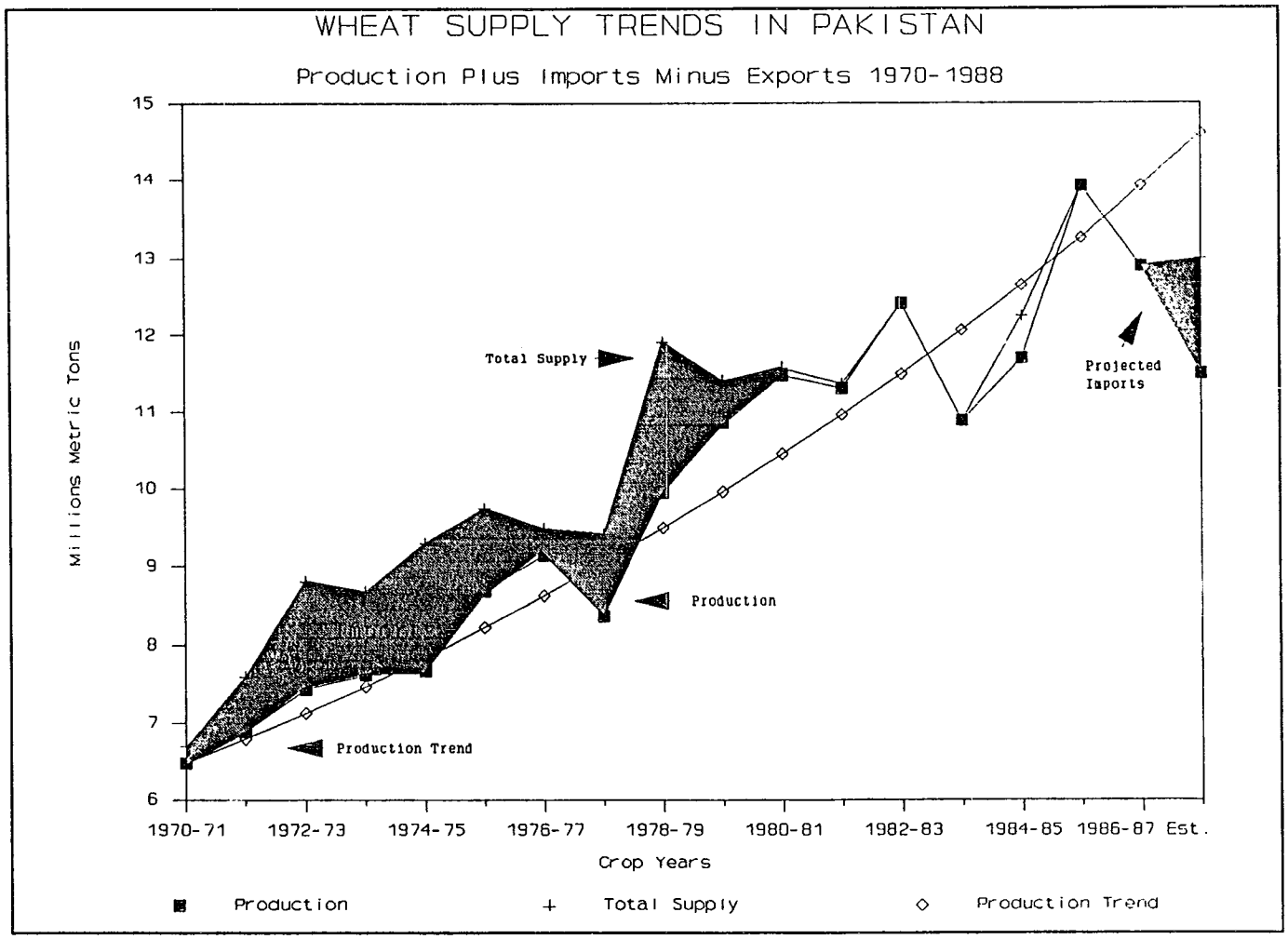
4th Quarter, 1989:

1. Conduct policy seminars on grain quality, and the operational impacts of the No Loss and FAQ policies.

2. Review and modify the GSRL recommendations for national grading standards, inspection procedures, and inventory management in view of the field tests, second field survey results, and outcome of seminars on these issues.

TECHNICAL ANNEX I.

A. Wheat Supply Trends in Pakistan
B. Wheat Production, Area, and Yields by Province
C. Sources of Protein and Calories in the Pakistan Diet
D. Pakistan Data on Wheat
E. Per Capita Availability of Wheat
F. Present and Projected Per Capita Consumption
G. Present and Projected Wheat Demand
H. Wheat Storage Capacities by Province and Ownership
I. Wheat Released by Provincial Food Departments
J. Surplus and Deficit Zones in Production and Consumption of Wheat
K. Wheat Marketing System
L. Origins of the "Fair Average Quality"


WHEAT SUPPLY TRENDS IN PAKISTAN
Production Plus Imports Minus Exports 1970-1988
Millions Metric Tons
15
14
13
12
11
10
9
8
7
6
Total Supply
Production
Production Trend
Projected Imports
1970-71
1972-73
1974-75
1976-77
1978-79
1980-81
1982-83
1984-85
1986-87 Est.
Crop Years
Production
Total Supply
Production Trend

Technical Annex I-B

WHEAT PRODUCTION, AREA AND YIELDS BY PROVINCE

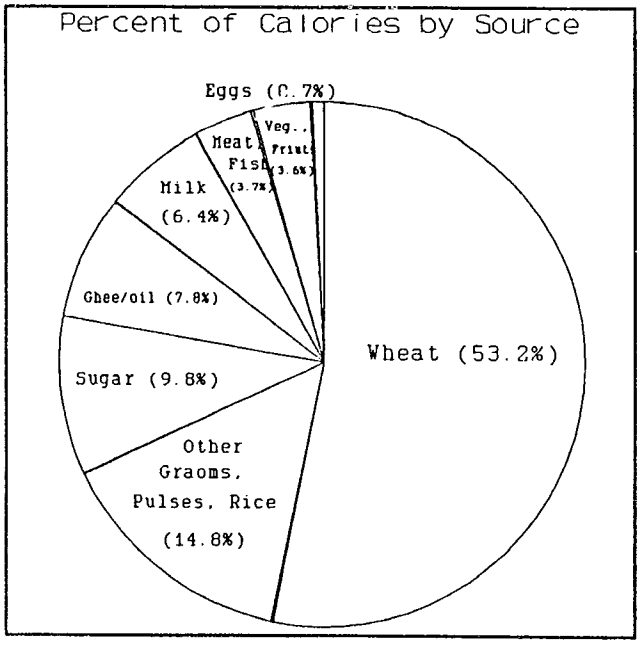
	PUNJAB			SIND		
Year	Area (000 ha)	Production (000 mt)	Yield (kg/ha)	Area (000 ha)	Production (000 mt)	Yield (kg/ha)
1970-71	4,389.5	4,948.2	1,127	837.3	1,120.7	1,338
1971-72	4,228.9	5,291.1	1,251	779.9	1,081.1	1,386
1972-73	4,366.5	5,693.5	1,304	770.6	1,095.8	1,422
1973-74	4,412.6	5,664.8	1,284	840.4	1,246.0	1,483
1974-75	4,216.3	5,785.6	1,372	755.5	1,143.6	1,514
1975-76	4,471.7	6,571.6	1,470	797.4	1,320.9	1,657
1976-77	4,598.0	6,807.7	1,481	927.2	1,478.6	1,595
1977-78	4,601.2	6,090.2	1,324	906.2	1,427.0	1,575
1978-79	4,806.0	7,323.6	1,524	1,008.6	1,680.1	1,666
1979-80	4,951.6	7,913.5	1,598	1,026.6	1,849.4	1,801
1980-81	4,978.0	8,350.0	1,677	1,030.0	1,945.8	1,889
1981-82	5,167.2	7,962.1	1,541	1,026.4	2,061.7	2,009
1982-83	5,285.0	8,935.1	1,691	1,008.7	2,066.7	2,049
1983-84	5,248.2	7,622.8	1,452	1,010.7	1,945.8	1,925
1984-85	5,165.7	8,315.1	1,610	1,029.8	2,078.7	2,019
1985-86	5,343.0	10,431.6	1,952	1,030.8	2,172.2	2,107

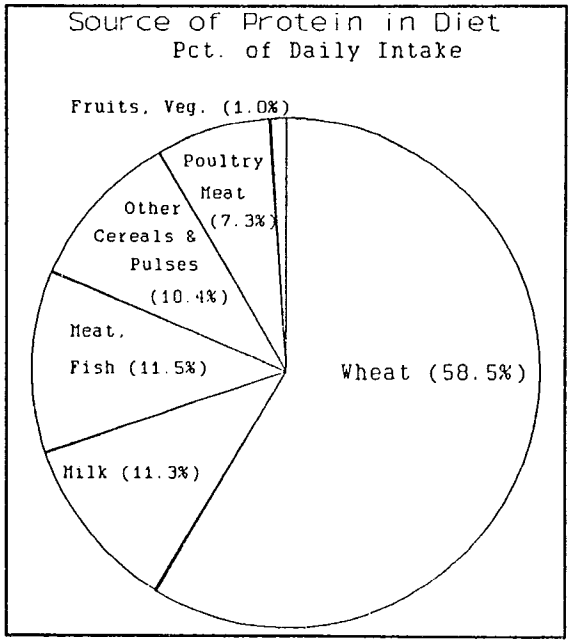
	NWFP			BALUCHISTAN		
Year	Area (000 ha)	Production (000 mt)	Yield (kg/ha)	Area (000 ha)	Production (000 mt)	Yield (kg/ha)
1970-71	589.6	331.2	562	161.1	76.2	473
1971-72	593.0	439.6	741	195.3	78.6	402
1972-73	683.9	584.4	855	149.5	68.6	459
1973-74	692.2	606.9	877	167.4	111.2	664
1974-75	694.9	613.2	882	145.6	131.1	900
1975-76	707.0	660.4	934	134.5	137.8	1,025
1976-77	716.8	711.6	993	148.1	146.0	986
1977-78	695.7	688.6	990	156.9	161.4	1,029
1978-79	704.7	737.5	1,047	167.8	208.8	1,244
1979-80	757.5	862.5	1,139	188.1	231.1	1,229
1980-81	790.4	940.8	1,190	185.3	238.0	1,284
1981-82	813.2	962.2	1,183	216.1	318.2	1,472
1982-83	824.5	998.4	1,211	279.7	414.2	1,481
1983-84	793.6	859.8	1,083	290.7	453.5	1,560
1984-85	785.6	872.1	1,110	277.4	437.1	1,576
1985-86	781.9	906.5	1,159	247.6	412.7	1,667

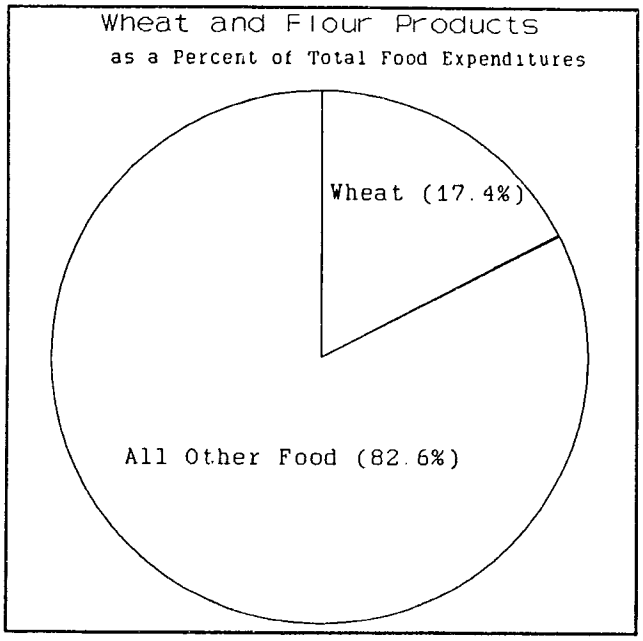
Source: Agricultural Statistics of Pakistan, 1983, 85, 86, Ministry of Food, Agriculture and Co-operatives, Food and Agriculture Division (Planning Unit)

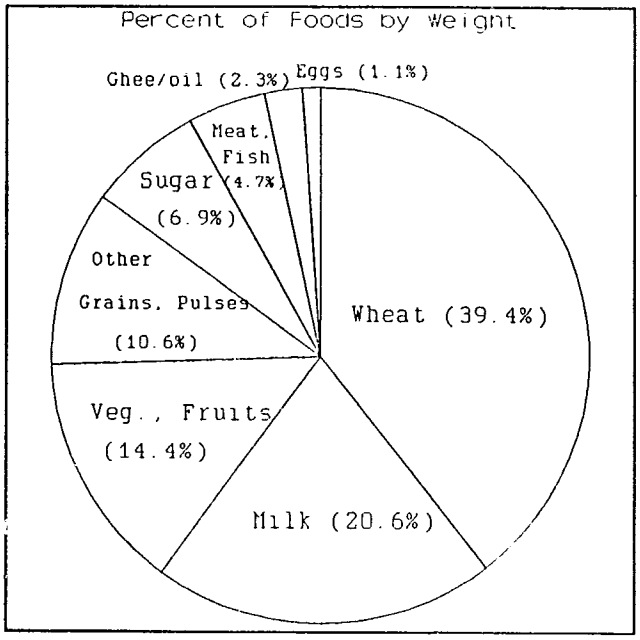
Technical Annex I-C

SOURCES OF PROTEIN AND CALORIES IN THE PAKISTAN DIET AND WHEAT AND FLOUR PRODUCTS AS A PERCENT OF TOTAL FOODS CONSUMED AND FOOD EXPENDITURES









Source: IFPRI-PIDE Surveys

PAKISTAN DATA ON WHEAT, PRODUCTION, CONSUMPTION AND STORAGE

Estimated wheat crop, 1988	12,900,000 Metric tons
US Bushel equivalent	469,173,000
(Kansas wheat est., 1988 - bushel)	319,600,000

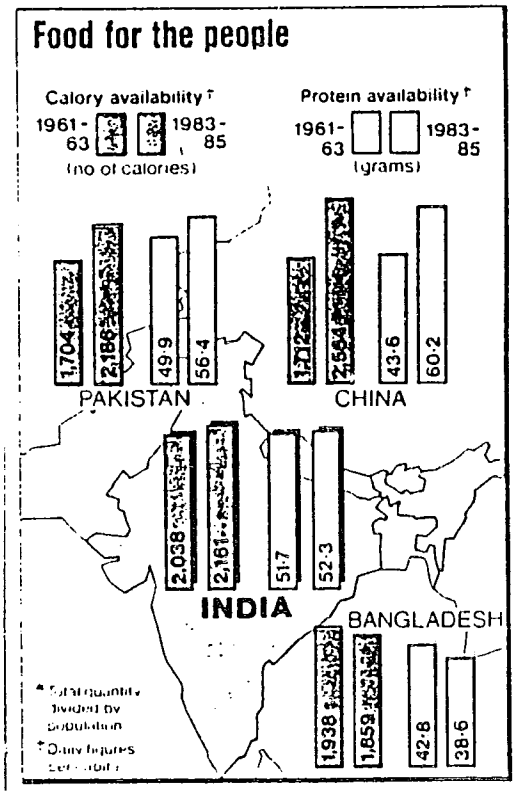
Govt. buying price for wheat - rp. 2,062.50 metric ton
Equivalent to $114.50 MT or $3.15 per bushel.

Wheat Storage Capacity - Metric Tons

Owners	Total	Percent
Federal & Provincial Govts.	2,936,122	67.8
PASSCO	438,200	10.1
World Bank Projects	500,050	11.5
National Logistics Cell	266,000	6.1
Other Govt. Agencies	41,500	1.0
Private Sector (commercial type storage)	150,450	3.5
	4,332,322	100.0

Wheat Purchases by Provincial Food Departments and PASSCO

Crop Year	Metric Tons
1984/85	4,707,300
1985/86	2,533,000
1986/87	5,035,000
1987/88	3,975,000



Source: South Magazine, August, 1988

Technical Annex I-E

PER CAPITA AVAILABILITY OF WHEAT

Year	Previous Year Gross Production ('000 mt)	1/ Net Production ('000 mt)	Current Year Imports (Exports) ('000 mt)	Avail-ability ('000 mt)	Popula - tion (Mio)	Per Capita Availabi. (k9/year)
1971-72	6,476	5,828	285	6,113	63.34	96.5
1972-73	6,890	6,201	690	6,891	65.89	104.6
1973-74	7,442	6,698	1,353	8,057	67.90	118.7
1974-75	7,629	6,866	1,229	8,095	69.98	115.7
1975-76	7,674	6,907	1,344	8,251	72.12	114.4
1976-77	8,690	7,821	1,186	9,007	74.33	121.2
1977-78	9,144	8,230	499	8,729	76.60	114.0
1978-79	8,367	7,530	1,052	8,582	78.94	108.7
1979-80	9,950	8,955	2,236	11,191	81.36	137.5
1980-81	10,857	9,771	602	10,373	83.84	123.7
1981-82	11,475	10,328	305	10,633	86.44	123.0
1982-83	11,304	10,174	(53)	10,121	89.12	113.6
1983-84	12,414	11,173	(191)	10,982	91.88	119.5
1984-85	10,920	9,828	545	10,373	94.73	109.5
1985-86	11,703	10,533	1,800	12,333	97.29	126.8
1986-87						

Notes: 1/ Reduction of 10% for seed, feed and losses

Source: Foodgrain Transport, Economics and Logistics Study, Table II-5 National Transport Research Center Planning and Development Division, Islamabad, December, 1985

Technical Annex I-F

PRESENT AND PROJECTED PER CAPITA CONSUMPTION

(kg/year)

Province	1984-85	1989-90	1999-20
NWFP, Baluchistan	118	123.9	137.5
Punjab	122	128.1	142.2
Sind	108	113.4	125.9
Pakistan	118	123.9	137.5

Source: Foodgrain Storage and Processing Study, Table 3.4.1
Agroprogress Kienbaum International, Bonn, West Germany

Technical Annex I-G

PRESENT AND PROJECTED WHEAT DEMAND

(1000 mt)

Province	1984-85	1989-90	1999-20
NWFP a)	1,529.5	1,864.8	2,506.6
Punjab	6,427.8	7,574.3	10,232.7
Sind	2,331.7	2,854.7	4,107.1
Baluchistan a)	642.4	901.9	1,704.0
Fata a), N.A., A. Kashmir	531.3	660.4	1,012.6
Pakistan	11,462.7	13,856.1	19,563.0

Source: Foodgrain Storage and Processing Study, Table 3.4.2
Agroprogress Kienbaum International, Bonn, West Germany

Technical Annex I-H

WHEAT STORAGE CAPACITIES BY PROVINCE AND OWNERSHIP

(mt)

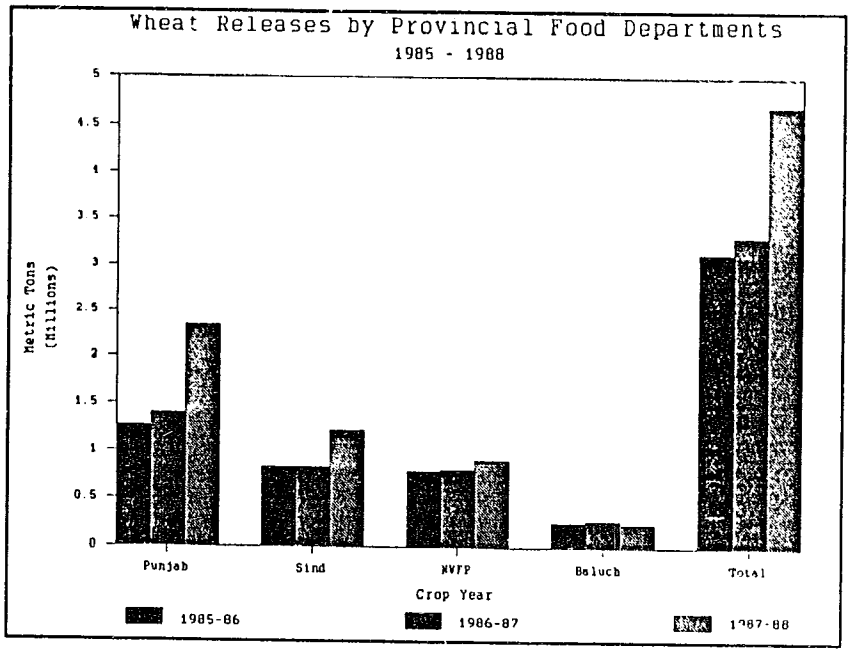
Owners	Punjab	Sind	N.W.F.P.	Baluchis.	Total
			Province		
Provincial and Federal Governments	1,947,500	539,620	329,300	119,702	2,936,122
World Bank Project	290,400	104,500	50,150	55,000	500,050
Private H.T.G.	55,300	81,660	9,000	4,500	150,460
A.D.P.	69,000	15,000			84,000
P.W.D. Stores			3,000		3,000
P.A.K./P.W.D.				4,500	4,500
PASSCO					
Silos	50,000	50,000			100,000
H.T.G.	300,300	26,000	9,900	2,200	338,800
NLC					
Silos	51,000	50,000		50,000	151,000
H.T.G.	20,000				20,000
H.T.G. & B.S.			85,000		85,000
Total	2,783,500	867,180	486,350	245,902	4,382,932

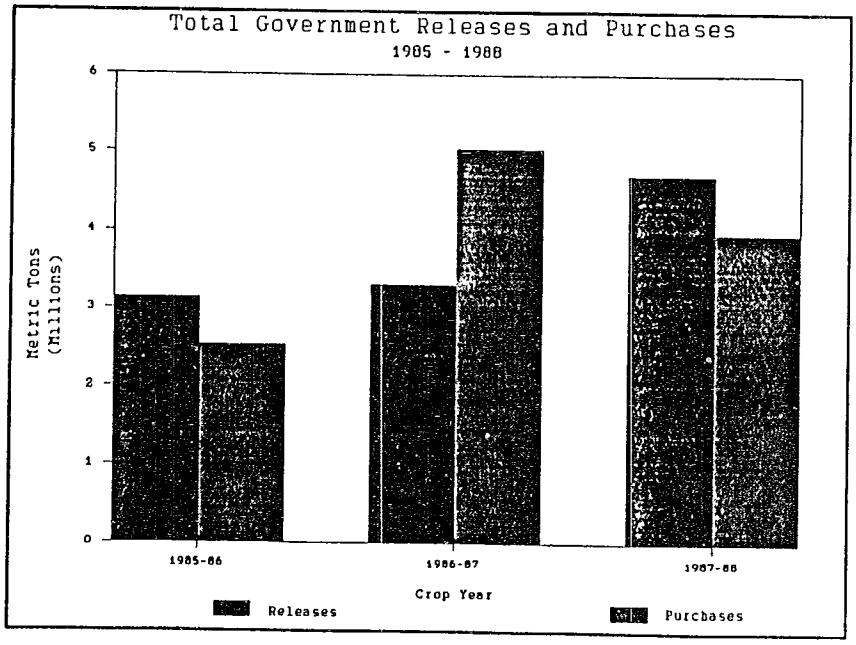
Source: Foodgrain Storage and Processing Study, Annex 2.4.1
Agroprogress Kienbaum, Bonn, West Germany

WHEAT RELEASES BY PROVINCIAL FOOD DEPARTMENTS
1985 - 1988

Year	Punjab	Sind	NWFP	(000 Tons Baluch.	Total Release	Total Purchases	Surplus (Deficit)
1985-86	1,260	829	789	255	3,133	2,533	(600)
1986-87	1,395	828	808	279	3,310	5,035	1,725
1987-88	2,341	1,220	904	238	4,703	3,975	(728)
			Percent Change				
1985-86							
1986-87	10.7	-0.1	2.4	9.4	5.6	98.8	
1987-88	67.8	47.3	11.9	-14.7	42.1	-21.1	

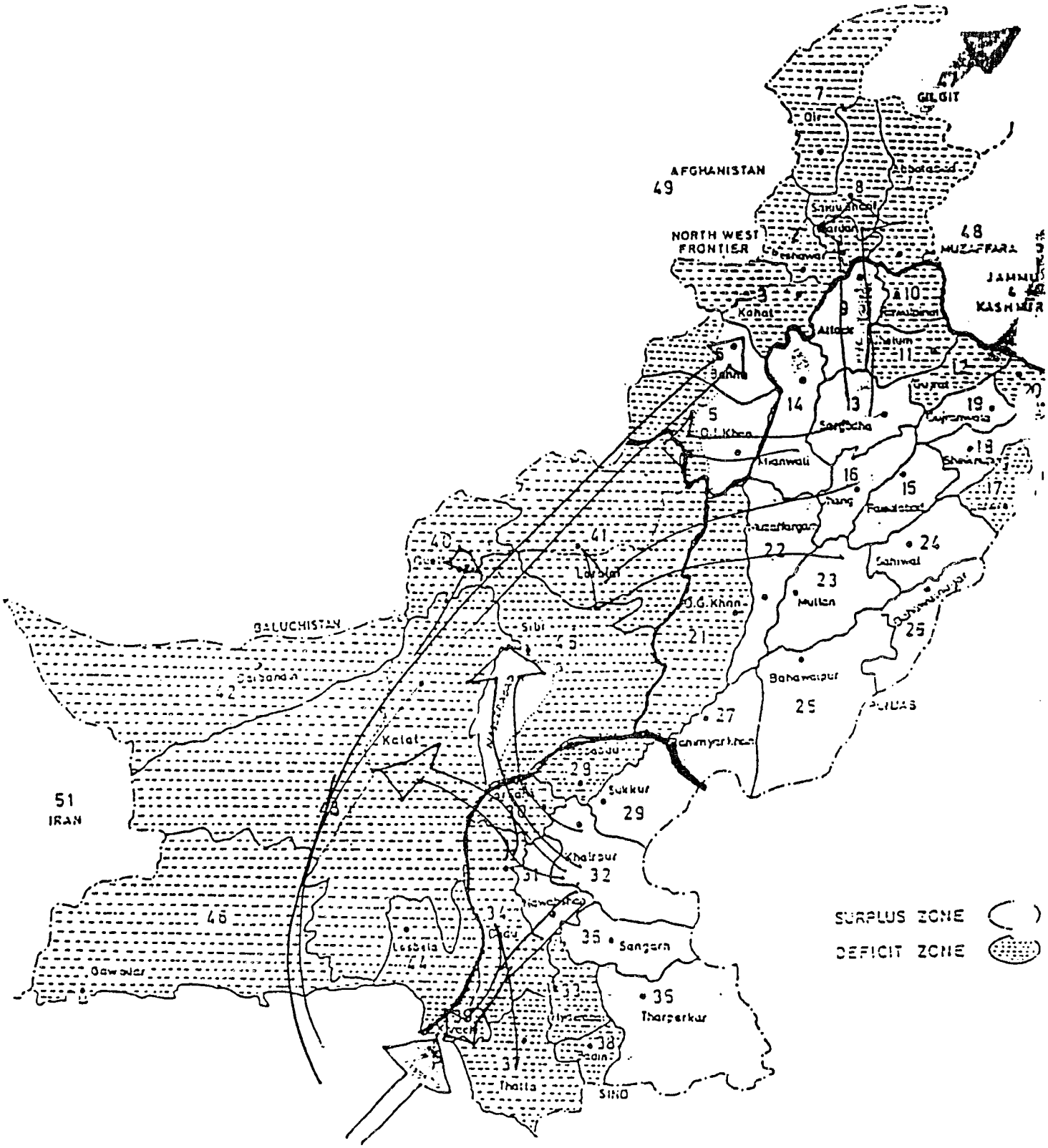
Source: MINFA, Wheat Cell





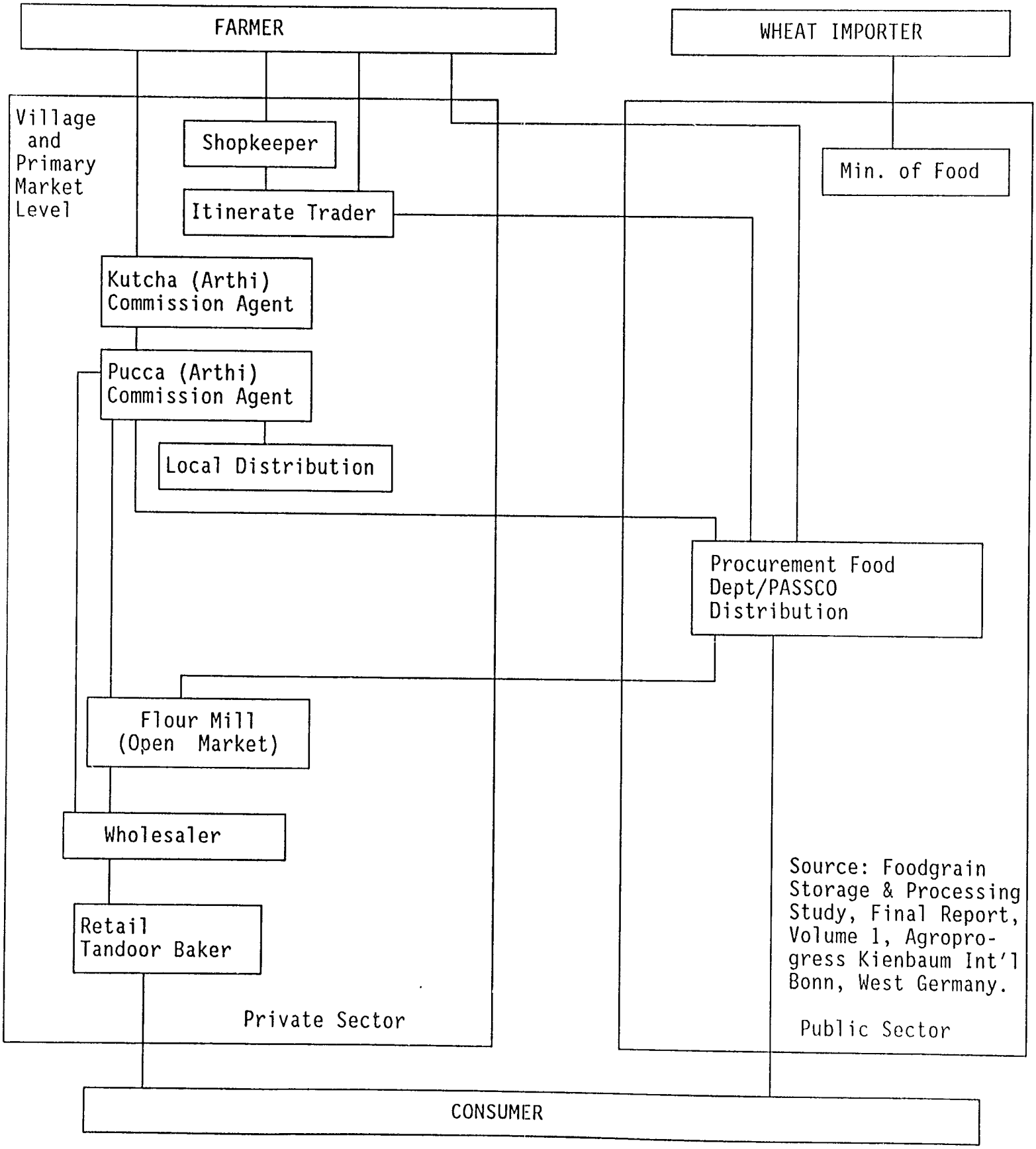
Technical Annex I-J

SURPLUS AND DEFICIT ZONES IN PRODUCTION AND CONSUMPTION OF WHEAT



Source: Foodgrain Transport Economics and Logistics Study, by Abdul Majeed, National Transport Center, Planning and Development Division, Islamabad, Pakistan, December, 1985.

WHEAT MARKETING SYSTEM (Commercial)
Main Channel



Source: Foodgrain Storage & Processing Study, Final Report, Volume 1, Agroprogress Kienbaum Int'l Bonn, West Germany.

Origins of the "Fair Average Quality" [23]

The sub-continent of the 1930's had developed a fairly sophisticated system for wheat marketing, including grain exchanges, grading systems, and "futures" contracts. The markets however, were locally or regionally oriented, each with its own set of won set of rules, customs, and traditions.

Wheat producers of that era generally tried to segregate their wheat on a variety and quality basis; selling their best and keeping the lower qualities for home consumption.

One of the key figures in the markets was the broker or "kachcha arhatyi" now commonly referred to as the "arthi". The broker did not purchase the wheat, but attempted to bring buyers and sellers together. One of the broker's primary selling methods was to pile small lots of wheat of varying quality into heaps or dara's and represent it as the "Fair Average Quality (FAQ)" of what was available in the area. Sale of the heap or dara was made by private negotiations or auctions, but the basis of sale was personal inspection and not the FAQ designation.

The local grain association or grain exchanges based their standards for futures contracts on the local FAQ definitions of "refractions" as a collective term for dirt, dockage, shrunken, broken, or damaged grains, and other non-wheat grains, but each element contained maximum limits, and premiums or deductions for deviations from the limits.

The local FAQ was defined each year at the beginning of the harvest season. Samples were commonly mailed to buyers in distant locations, who would then order by telegraph or telephone the local FAQ (Multan, Lyallpur, Okara, etc.) for future delivery. The FAQ was not intended for use in the "ready" or "spot" sales. It must also be pointed out that FAQ transactions were made between grain specialists or professionals who knew and could evaluate the quality factors in wheat. Arbitration methods were available in case of disputes in courts of law or through the grain exchanges. The FAQ was little used in most of colonial India except for regions that now comprises Pakistan. An attempt was made to standardize grain contract specifications at a government and industry conference in Dehli in 1936. The suggested contract specifications are remarkably similar to the FAQ specifications in use today.

The current wheat marketing problems in Pakistan were recognized in an earlier era. Wheat grading at the producer level seldom paid due to the unwillingness of buyers to pay premiums for certain quality characteristics. There is a tendency for low quality to drag down the price of higher qualities. In FAQ

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[23] Based upon "Report on the Marketing of Wheat in India:, Marketing Series No. 1, Agricultural Marketing In India, Simla: Government Press of India, 1937. 454 pages in English, 104 pages Urdu summary.

sales, the high quality carries the lower quality, and the producer of low quality becomes overpaid for produce. A system of deductions for "karda"[24] or impurities in the wheat as marketed (either real or imagined) has become highly institutionalized. Producers long ago recognized the practical effects, and where "karda" is practiced "... any cultivator with a modicum of sense makes sure that his wheat is adulterated beyond the limits of the customary 'karda'".[25]

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[24] Literal translation is dirt. In Lahore, 'Karda' was deducted at fix rate of 1 seer per bag of 2.5 maunds, or 1%.

[25] Marketing of Wheat in India op. cit. p. 200.

TECHNICAL ANNEX II.

A. Kernel Structure and Effects on Processing, Distribution and Consumption
B. Chemical Composition and Biological of Commercial Wheat Varieties of Pakistan
C. Lysine Content, Biological Values, and Available Carbohydrate, in Relation to Protein Content of Commercial Varieties
D. Volume Factor After Cleaning
E. Expressing Moisture Content of Grain
F. Wheat Cleaning Analysis User's Guide
G. Weight Losses Caused by Insects
H. Real and Apparent Weight Loss
I. Average Reproduction and Feed Requirements of Rate

KERNEL STRUCTURE AND EFFECTS ON PROCESSING, DISTRIBUTION AND CONSUMPTION

Significance in	Parameter	Effect	Commodity
Threshing	Germ damage or skinning	Reduced germinability, impaired storability	All cereal grains
Drying	Cracks, fissures, and breakage; hardening	Reduced commercial value; lowered grade, impaired storability, dust formation reduced starch yield	Mainly corn and rice
	Discoloration	Reduced commercial value, lowered grade	Mainly rice
Marketing	Breakage	Reduced commercial value in food processing	Mainly corn and rice
General use	High husk; caryopsia ration or high paricarp; endosperm ratio	Reduced nutritional value - as food or food	All cereal grains
General use	Kernel shape and dimensions proportions of tissues in the kernel, distribution of nutrients in the tissues	Yield of food products; nutritional value of cereal (or cereal products) as food or feed	All cereal grains
Malting	Germ damage, skinning, or inadequate husk adherence	Reduced germinability uneven malting	Mainly barley
Milling	Uneven surface, deep crease or uneven aleurone	Reduced milling yield	Mainly wheat and rice
Milling	Steely texture	Increased power requirements, starch damage, high water abosorption difficulty in air classification	Wheat and malt milling
Germination Malting	Starch granule	Uneven degradation	All cereal grains
Consumption - Nutrition	Distribution and composition of proteins	Change in nutrition value	All cereal grains

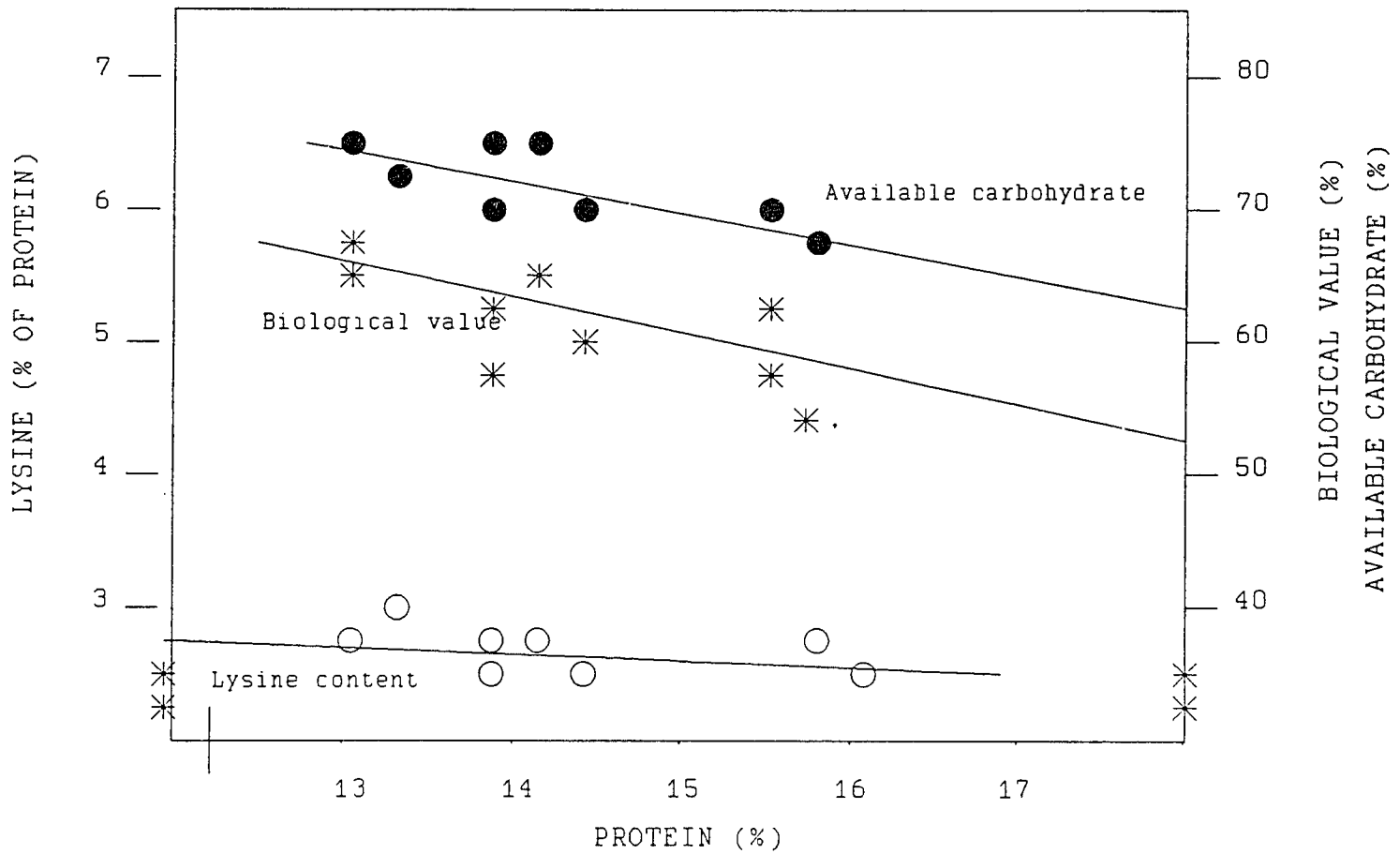
Source: Pomeranz and Bechtel, "Structure of Cereal Grains as Related to End-Use Properties", in Postharvest Biology and Biotechnology, Hultin and Milner, eds., Food & Nutrition Press, Westport, Connecticut.

CHEMICAL COMPOSITION (ONE DAY BASIS) AND BIOLOGICAL OF SOME COMMERCIAL WHEAT VARIETIES

Wheat Variety	'Sonalika'	'Lyp-73'	'Pak-81'	'Sind'	'Sarhad-81'	'Faisal-abad-83'	'Punjab-83'	'Barani-83'
Protein (N x 5.7) %	15.7	14.8	14.3	13.3	14.5	14.3	13.2	16.0
Fat %	2.7	2.7	2.9	2.7	2.7	2.6	2.7	3.0
Available CHO %	68.6	70.0	72.5	72.9	72.7	70.8	74.4	67.3
Crude Fibre %	2.2	2.5	2.5	2.2	2.7	2.6	2.8	2.9
Ash %	1.6	1.7	1.6	1.5	1.5	1.6	1.6	1.7
Calcium mg/100g	37.0	11.0	18.0	25.0	20.0	30.0	40.0	19.0
Phosphorus mg/100g	336.0	315.0	287.0	310.0	284.0	319.0	325.0	309.0
Iron mg/100g	4.8	3.9	4.1	4.5	3.8	2.9	4.2	3.3
Zinc mg/100g	3.3	2.8	3.0	3.5	4.1	2.9	3.7	2.5
Lysine g/16g N	2.62	2.54	2.63	2.71	2.60	2.48	2.75	2.46
Methionine + Cystine g/16g N	3.88	3.77	3.62	3.83	3.45	3.56	3.70	3.48
True Protein	92.0	93.0	93.0	95.0	92.0	94.0	95.0	94.0
Digestibility %								
Biological Value %	62.0	61.0	63.0	66.0	65.0	58.0	68.0	56.0
Net Protein Utilization %	57.0	57.0	59.0	63.0	60.0	55.0	65.0	53.0
Utilizable Protein %	10.2	9.2	9.1	9.2	9.5	8.5	8.9	10.0

Source: PARC Annual Report, 1985

LYSINE CONTENT, BIOLOGICAL VALUES, AND AVAILABLE CARBOHYDRATE IN RELATION PROTEIN CONTENT OF COMMERCIAL WHEAT VARIETIES



Source: PARC Annual Report, 1985

Volume Factor after Cleaning

Initial Impurity (%)	Impurity after Cleaning (%)										
	0.0%	1.0%	2.0%	3.0%	4.0%	5.0%	6.0%	7.0%	8.0%	9.0%	10.0%
0.0%	1.0000										
1.0%	0.9900	1.0000									
2.0%	0.9800	0.9899	1.0000								
3.0%	0.9700	0.9798	0.9898	1.0000							
4.0%	0.9600	0.9697	0.9796	0.9897	1.0000						
5.0%	0.9500	0.9596	0.9694	0.9794	0.9896	1.0000					
6.0%	0.9400	0.9495	0.9592	0.9691	0.9792	0.9895	1.0000				
7.0%	0.9300	0.9394	0.9490	0.9588	0.9688	0.9789	0.9894	1.0000			
8.0%	0.9200	0.9293	0.9388	0.9485	0.9583	0.9684	0.9781	0.9891	1.0000		
9.0%	0.9100	0.9192	0.9286	0.9381	0.9479	0.9579	0.9681	0.9785	0.9891	1.0000	
10.0%	0.9000	0.9091	0.9184	0.9278	0.9375	0.9474	0.9574	0.9677	0.9783	0.9890	1.0000

Volume Factor after Drying

Initial Hunidity (%)	Humidity after Drying (%)										
	12.0%	13.0%	14.0%	15.0%	16.0%	17.0%	18.0%	19.0%	20.0%	21.0%	22.0%
12.0%	1.0000										
13.0%	0.9886	1.0000									
14.0%	0.9733	0.9885	1.0000								
15.0%	0.9659	0.9770	0.9884	1.0000							
16.0%	0.9545	0.9655	0.9767	0.9882	1.0000						
17.0%	0.9432	0.9540	0.9651	0.9765	0.9881	1.0000					
18.0%	0.9318	0.9425	0.9535	0.9647	0.9762	0.9880	1.0000				
19.0%	0.9205	0.9310	0.9419	0.9529	0.9643	0.9759	0.9878	1.0000			
20.0%	0.9091	0.9195	0.9302	0.9412	0.9524	0.9639	0.9756	0.9877	1.0000		
21.0%	0.8977	0.9080	0.9186	0.9294	0.9405	0.9518	0.9634	0.9753	0.9875	1.0000	
22.0%	0.8864	0.8966	0.9070	0.9176	0.9286	0.9398	0.9512	0.9630	0.9750	0.9873	1.0000

How to calculate and use volume factors:

1. Find initial impurity percentage on left scale, read across to column headed by impurity percentage after cleaning, read number. This is the volume factor for the grain after cleaning.

2. Find initial humidity percentage on left scale, read across to column headed by the humidity percentage after cleaning, read number. This is the volume factor for the grain after drying.

3. Multiply the impurities volume factor x the humidity volume factor to obtain the volume factor for grain remaining after cleaning and drying.

Example: 1,000 kg. grain harvested with following characteristics

Grain harvested with 4.0% impurities and 19.0% humidity will be cleaned and dried to 1% impurities and 14.0% humidity.

Intersection of 4.0% initial impurity and 1.0% impurities after cleaning is .9697.

Intersection of 19.0% initial humidity and 14.0% humidity after drying is .9419.

.9697 x .9419 = .9133. 1,000 x .9133 = 913.3 kg. of grain remaining after cleaning and drying.

FINAL VOLUME FACTOR

Impurities Factor	Moisture Factor 1.0000	0.9900	0.9800	0.9700	0.9600	0.9500	0.9400	0.9300	0.9200	0.9100	0.9000
1.0000	1.0000	0.9900	0.9800	0.9700	0.9600	0.9500	0.9400	0.9300	0.9200	0.9100	
0.9900	0.9900	0.9801	0.9702	0.9603	0.9504	0.9405	0.9306	0.9207	0.9108	0.9009	
0.9800	0.9800	0.9702	0.9604	0.9506	0.9408	0.9310	0.9212	0.9114	0.9016	0.8918	
0.9700	0.9700	0.9603	0.9506	0.9409	0.9312	0.9215	0.9118	0.9021	0.8924	0.8827	
0.9600	0.9600	0.9504	0.9408	0.9312	0.9216	0.9120	0.9024	0.8928	0.8832	0.8736	
0.9500	0.9500	0.9405	0.9310	0.9215	0.9120	0.9025	0.8930	0.8835	0.8740	0.8645	
0.9400	0.9400	0.9306	0.9212	0.9118	0.9024	0.8930	0.8836	0.8742	0.8648	0.8554	
0.9300	0.9300	0.9207	0.9114	0.9021	0.8928	0.8835	0.8742	0.8649	0.8556	0.8463	
0.9200	0.9200	0.9108	0.9016	0.8924	0.8832	0.8740	0.8648	0.8556	0.8464	0.8372	
0.9100	0.9100	0.9009	0.8918	0.8827	0.8736	0.8645	0.8554	0.8463	0.8372	0.8281	
0.9000	0.9000	0.8910	0.8820	0.8730	0.8640	0.8550	0.8460	0.8370	0.8280	0.8190	

Impurities Factor	Moisture Factor 0.8900	0.8800	0.8700	0.8600	0.8500	0.8400	0.8300	0.8200	0.8100	0.8000	0.7900
1.0000	0.8900	0.8800	0.8700	0.8600	0.8500	0.8400	0.8300	0.8200	0.8100	0.8000	
0.9900	0.8811	0.8712	0.8613	0.8514	0.8415	0.8316	0.8217	0.8118	0.8019	0.7920	
0.9800	0.8722	0.8624	0.8526	0.8428	0.8330	0.8232	0.8134	0.8036	0.7938	0.7840	
0.9700	0.8633	0.8536	0.8439	0.8342	0.8245	0.8148	0.8051	0.7954	0.7857	0.7760	
0.9600	0.8544	0.8448	0.8352	0.8256	0.8160	0.8064	0.7968	0.7872	0.7776	0.7680	
0.9500	0.8455	0.8360	0.8265	0.8170	0.8075	0.7980	0.7885	0.7790	0.7695	0.7600	
0.9400	0.8366	0.8272	0.8178	0.8084	0.7990	0.7896	0.7802	0.7708	0.7614	0.7520	
0.9300	0.8277	0.8184	0.8091	0.7998	0.7905	0.7812	0.7719	0.7626	0.7533	0.7440	
0.9200	0.8188	0.8096	0.8004	0.7912	0.7820	0.7728	0.7636	0.7544	0.7452	0.7360	
0.9100	0.8099	0.8008	0.7917	0.7826	0.7735	0.7644	0.7553	0.7462	0.7371	0.7280	
0.9000	0.8010	0.7920	0.7830	0.7740	0.7650	0.7560	0.7470	0.7380	0.7290	0.7200	

How to use this table:

As alternative to (impurity volume factor) x (humidity volume factor), look up humidity and volume factors nearest the impurity and volume factors obtained from the previous tables. Read down and across to get the final volume factors.

Example: From previous page with 4.0% impurity and 19.0% humidity, read down impurities column to .9700 and across humidity column to .9400. The intersection is .9118. The true calculated value is .9133. For estimating purposes, the difference is only .0015, or 1.5 kg. per 1,000 kg.

EXPRESSING MOISTURE CONTENT OF GRAIN

A. Wet basis - used in grain marketing and storage:

$$\% \text{ moisture content } (m) = \frac{\text{weight of water}}{\text{weight of grain}} \times 100 = \frac{Wm}{Wm + Wd} \times 100$$

where: Wm = weight of water
Wd = weight of dry grain in a sample
m = percent moisture content in wet basis

B. Dry basis - used in science and engineering

$$\% \text{ moisture content } (m) = \frac{\text{weight of water}}{\text{weight of dry grain}} \times 100 = \frac{Wm}{Wd} \times 100$$

where: m = percent moisture content in dry basis

Conversion:

Dry basis moisture content can easily be converted into wet basis moisture content by the following expression:

$$m\ (\%) = \frac{100\ m}{100 + m}$$

Wet basis moisture content can also be converted into dry basis moisture content by the following expression:

$$m\ (\%) = \frac{100\ m}{100 - m}$$

Example: A 10g sample weighs 8g after complete removal of moisture by drying. What is the moisture content in wet basis? In dry basis?

Wet basis: $m\ (\%) = \frac{10 - 8}{10} \times 100 = 20\%$

Dry basis: $m\ (\%) = \frac{2}{8} \times 100 = 25\%$

ANSWERQuick

Wheat Cleaning Analysis User's Guide

An electronic spreadsheet template designed to help grain elevator operators do these tasks:

- **Assess the profitability of cleaning**
- **Calculate the payback period for cleaning equipment**
- **Print the results for permanent records of the analysis**

Cooperative Extension Service
Kansas State University, Manhattan

WHEAT CLEANING ANALYSIS -- Lotus 1-2-3 -- 08/01/87

I -- QUANTITY/SHIPPING INPUTS

		Not Cleaned	Cleaned	Difference
A.	Annual lbs. handled	50000000	50000000	
B.	Percent removed		0.70%	
C.	Percent shrinkage		0.10%	
D.	Lbs. cleanings		350000	
E.	Cleanings price ($/cwt)		$0.75	
F.	Lbs. shipped	50000000	49600000	
G.	Actual dockage (%)	0.83%	0.43%	
H.	FGIS dockage (%)	0.8%	0.4%	
I.	Settlement lbs.	49600000	49401600	198400
J.	Settlement bu.	826666.7	823360.0	3306.7
K.	Market price ($/bu.)	$2.00	$2.00	$0.00
L.	Shipping cost ($/cwt)	$0.34	$0.34	
M.	Shipping costs ($)	$170,000.00	$168,640.00	$1,360.00

II -- GRADING FACTOR INPUTS

		Not Cleaned	discount	Cleaned	discount
A.	Test Weight (lbs.)	58	$0.010	60	$0.000
B.	Damaged kernels (%)	0.5%	$0.000	0.4%	$0.000
C.	Foreign matter (%)	0.5%	$0.005	0.5%	$0.005
D.	Shrunk & Broken (%)	1.0%	$0.000	0.4%	$0.000
E.	Total defects (%)	2.0%	$0.000	1.3%	$0.000
F.	Total discount ($)		$0.015		$0.005
G.	Net price rec'd/bu. ($)		$1.99		$2.00

III -- CLEANING COST INPUTS

		Inputs	Results	Cost
A.	Pounds cleaned per hour	120000		
B.	Hours operated		416.7	
C.	Cost per hour	$10.00		
D.	Operation cost			$4,166.67
E.	Equipment life (yrs)	7		
F.	Equipment purchase price	$25,000.00		
G.	Annual depreciation			$3,571.43
H.	Annual interest rate (%)	12.0%		
I.	Term length of loan (yrs)	10		
J.	Total interest cost		$19,246.04	
K.	Annual interest cost			$1,924.60
L.	Total cleaning cost per year			$9,662.70
M.	Cleaning benefits ($/bu.)	$0.0006		$496.00

IV -- FEASIBILITY ANALYSIS RESULTS

		Not Cleaned	Cleaned
A.	Value of Cleanings		$2,625.00
B.	Gross Receipts	$1,640,933.33	$1,645,228.20
C.	Net Receipts	$1,470,437.33	$1,466,925.50
D.	Cleaning profit per year (loss)		($3,511.83)
E.	Profit (loss) of cleaning/bu.		($0.0043)

FEASIBILITY OF CLEANING

F.	Equipment life	7.0
G.	Years for equipment payback	-12.6
H.	Analysis result	NOT FEASIBLE

Technical Annex II-H

WEIGHT LOSSES CAUSED BY INSECTS

An example provided by the World Bank study which shows the potential for losses caused by insects based on their reproduction rate and a daily grain consumption of 1 milligram per insect.

POTENTIAL BREEDING OF STORAGE INSECTS

Period Month	No. of Insects Per Day	Grain Consumption Per Month	Grain Consumption
1	100	100 mg	0.0003 kg
2	10,000	10,000 mg	0.3 kg
3	1,000,000	10 lakh mg	30 kg
4	100,000,000	10 crore mg	300 kg
5	10,000,000,000	1,000 crore mg	300,000 kg

Source: Operational Manual, Agroprogress Kienbaum Int. GmbH, 1986, p. 74.

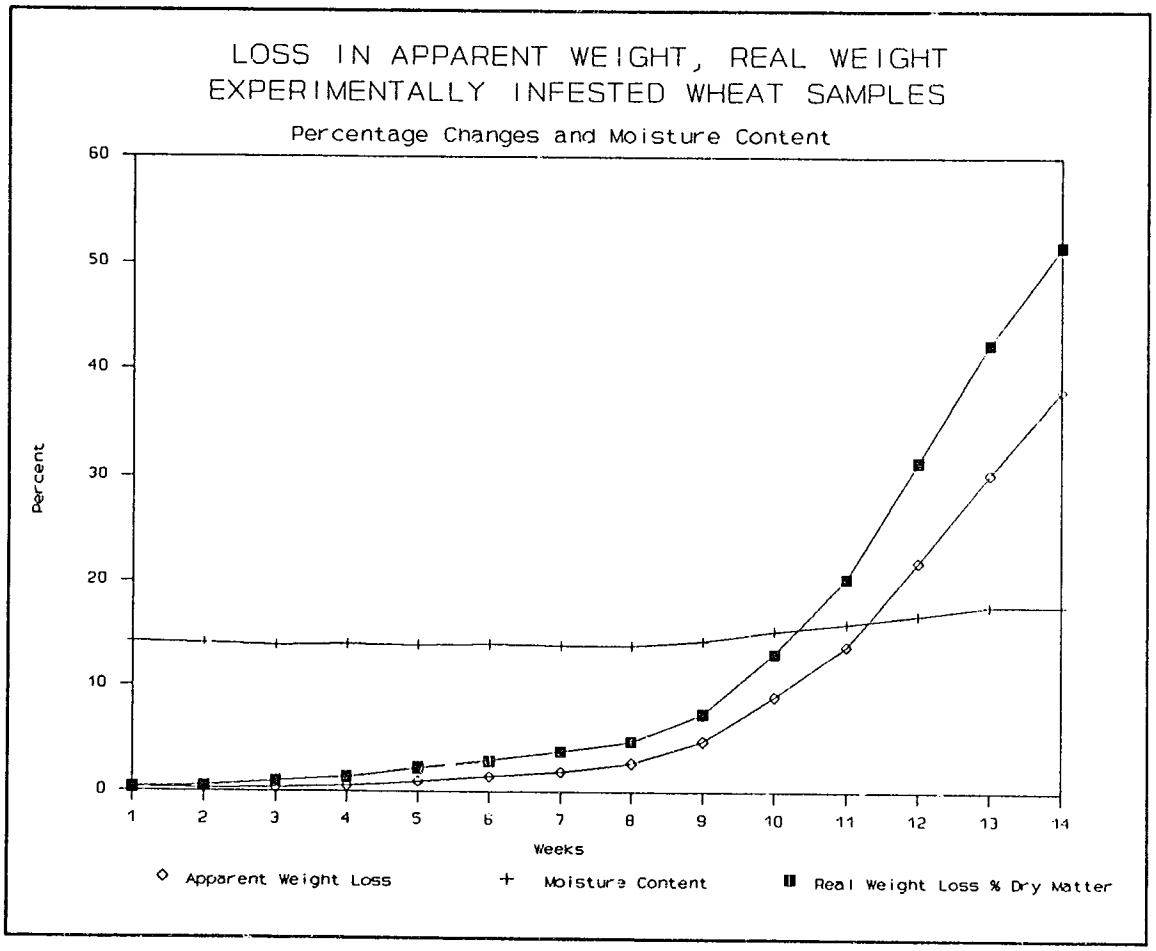
The above example assumes no interference in insect reproduction due to control measures or changes in environmental conditions. If such insect losses were projected to a food security reserve of 1,000,000 mt with a 5 percent level of losses, each day insects will consume 70 mt. The 70 mt lost would have provided the grain requirements for 200,000 people.

Another factor to note is the rapid build up in populations after the second month, and the value of taking protective measures early in the storage cycle.

Technical Annex II-I

REAL AND APPARENT WEIGHT LOSS

Weight loss in longer term storage become exponential over time as shown in the following figure. The difference between the real and apparent wight losses is the weight of the live insects, insect fragments, and dust generated by insect activity. In this instance, the weight added by the grain borer S.oryzae is approximately equal to the weight losses that can be detected by "before" and "after" weighing. Inspection and laboratory testing of grain is needed in each instance to determine the real and apparent weight losses.



Source: Loss of Dry Matter and Nutritive Value in Experimentally Infested Wheat, by B.J. Francis and J.M. Adams, Tropical Science, Volume 22, Number 1, 1980.

For field survey work in wheat and other grains, weight loss is calculated in percentages by multiplying 1/8 to 1/2 times the percent of infested or damaged grains, depending upon the particular species of insects involved. Thus damage percentages mean little unless accompanied by the insect species.

AVERAGE REPRODUCTION AND FEED REQUIREMENTS OF RATS

Months	No. of Rats	Feed requirements in kg.	
		per day	per 3 months
0	2	0.02	3.6
3	8	0.16	14.4
6	32	0.64	57.6
9	130	2.60	234.0
12	520	10.40	936.0

Source: Agroprogress Kienbaum Int. GmbH. "Operations Manual", p. 94.

One rat consumes about 20-25 g. grain per day equivalent to approximately 9 kg/year. It will also release 10,000 droppings, 4 litres urine, and a constant shed of about 5 lakh hairs annually.

One female rat will live for about one year and will breed 4-5 times during this period. It may have up to 16
young in a single litter, but on average 6-10 offspring every 2-3 months. Within in one year the offsprings from a single female will amount to 500 rats on average and even more under favorable conditions.

TECHNICAL ANNEX III.

A. Objectives of Grain Storage Research Laboratory
B. Synopsis of Loss Estimates by Different Authors and Institutes
C. Extract of PASSCO Field Manual, June, 1985
D. Extracts from Government of Sind Food Department Wheat Policy
E. Extracts from Salient Features of the Wheat Procurement Policy 1986-87
F. Extracts on No Loss Policy

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OBJECTIVES

GRAIN STORAGE RESEARCH LABORATORY
PAKISTAN AGRICULTURAL RESEARCH COUNCIL
MALIR HALT, KARACHI - 27.

1. To study the distribution, biology and ecology of important insects and fungi associated with stored grains.

2. To estimate the extent of quantitative and economic losses associated with physical, biology and socio-economic environments at the farm and the market locations in different agro-ecological zones.

3. To conduct filed experiments to improve the current storage practices and to evolve new techniques to prevent storage losses at the farm and market level.

4. To estimate grain losses in different types of government godowns, especially in Karachi and Hyderabad areas and to advise the government on future policy and programme for developing suitable storage facilities.

5. To disseminate available information on grain storage and to organize regular training courses for extension workers and the officials involved in grain storage.

SYNOPSIS OF LOSS ESTIMATES BY DIFFERENT AUTHORS AND INSTITUTIONS

Level and Causes of Losses	Loss Estimates in %					
	Chaudhry 1980	FAO 1984 1985	Akber 1981 Quayyum 1977 1978	Ahmed 1984 Cheema 1978 Fulk 1980	GSRL 1983 Ahmed 1985 Akber 1981	Assump. of FAQ/ INDUS Team
Farm Level:						
harvesting		0.4			2.8-4.5	2.5
threshing/handling /transport	1.6	1.0			1.5	1.5
storage:						
rodents/birds	1.5	4.0	5-10	4.6		1.5
insects						3.5
Sub total						9.0
Market Agents and Private Storage:						
handling/transport storage	7.8					5.0
Sub total						5.0
Public Sector:						
handling/transport storage						
weather/mould						
insects	5.1	2.5		4.0	3.5	3.5
respiration				0.4		0.4
Sub total						5.0

Source: Agroprogress Kienbaum and Indus Associated Consultants, Food Grain Storage and Processing Study, Vol. 1, Final report, p. 63, Bonn, West Germany and Lahore, Pakistan 1987.

Technical Annex III-C

EXTRACT OF PASSCO FIELD MANUAL, JUNE, 1985

Functions of Zonal Office (p.13)

7. Exercise vigilance in the zone to avoid qualitative loss due to negligence of the staff.

15. Fix the responsibility for shortage and effect recovery on any loss thus occurring to the corporation.

Duties of Staff in the Zonal Office (p.18)

2. He will exercise economy by adopting ways and means to safeguard against any pilferage, deterioration in quality of stocks of grain and dead stock items and quantitative loss like ground shortages due to negligence or willful involvement of the staff.

4. Will allocate targets of procurement to the projects, plan movement of wheat from purchase centers to reservoirs/godowns its despatch to recipient agencies without quality or quantity loss 'on ground' or 'in transit'. The zonal plans shall be integrated into Master plan of procurement operation at Head Office.

5. Settle the shortage if any reported on movement of wheat from purchase centers to reservoirs/godowns.

18. Will organize training for the personnel during the lean period.

21. Will prepare/submit procurement/storage/despatch plan of the zone to Head Office for consideration and finalization.

22. Will prepare/submit the seasonal requirement of bardana/tarpaulins/weighing scales/sutli/date mats/polytene/ropes/fumigants to Head Office for their timely arrangements.

23. Will prepare/submit the seasonal requirement of funds to Head Office for timely arrangements.

Duties of DPM Zone (p.21)

7. Will coordinate the movement of wheat from the purchase centers to reservoirs/godowns and consolidate the internal shortage on local shifting. He will take immediate steps to settle this and the shortage which could not be settled at the end of calendar month shall be put up to the Zonal Head for his final decision.

8. Will ensure that remedial action are taken on the inspection reports.

Duties of Office Superintendent (p.23)

17. Will take immediate remedial measure on inspection observations made by the Head Office or the Zonal Head.

20. Will process actions on the discrepancies pointed out at the time of handing taking over and keep on record the duplicate copy of all the handling/taking proceedings of the zone for reference.

Purchase Officer (Stock) (p.27)

4. Will maintain the shortage and discrepancy register for all types of shortages i.e., transit, ground and shortage on local transfer of stocks within the zone and the projects. He will daily put up the state for local transfer shortage to DPM zone for settlement and suitable action. For other shortages refer to the chapter on shortages.

5. He will compile quarterly the reconciled data regarding cereal grain and dead stock items for annual stock taking by the Head Office teams and monthly inspections of the Zonal Head.

11. Keep record of all the observations made regarding the weight quality of stock, state of infestation use of dunnage and sutli etc. and recommend remedial measures to the DPM zone based on the reports.

14. Will prepare seasonal requirement of bardana/tarpaulins/weighing scales/sutli/date mats/ polytene/bricks and fumigants for submission to Head Office.

Assistant Purchase Inspector (p.29)

5. Every unit of storage i.e., one gangi, one bin, one godown at each storage point shall be recorded by him and reconciled for the purpose of stock, despatch and damage of wheat etc.

6. Will maintain fumigation record, infestation of stock if any and the remedial measures taken till the grains are free of it.

7. Will record the extracts from audit and inspection reports regarding shortage, condition of stocks, storage arrangements, correct use of dunnage, storage practices, moisture contents, storage grain and the storage practices.

8. Will record and maintain the transactions in stocks year-wise and crop-wise.

9. Will intimate to Accounts Section regarding recoveries from the staff on account of shortages of grain.

Functions of the Project Office (p.41)

3. Exercise supervisory control over the stocks or cereal grain and dead stock items.

5. Data processing, compilation and submission regarding procurement, despatches, reclassification of tarpaulins, damage wheat, use of dunnage, fumigation, labor/carriage bills, sales accounts and incidental accounts.

6. Allocation of project procurement targets to various centers.

8. Plan storage wheat procured at various reservoirs and godowns.

10. Ensure that pest control measures are followed.

13. Work out all types of shortages in the project and take immediate measures to settle these.

Duties of Project Manager (p.43)

4. Will carry out detailed inspection of all the storage points fortnightly on 1st and 15th of every month for inspection refer to chapter on inspections.

6. Will ensure that quantity of wheat or paddy received is accounted for and correct for weight and quality.

9. Will ensure implementation of pest control measures as per 'Manual on Pest Control of Stored Grain'.

Duties of Purchase Officer Project (p.45)

8. Will assist stock taking boards, inspection audit teams.

Duties of Junior Assistant (Administration) (p.47)

6. Will maintain permanent record of handing/taking over proceedings and the discrepancies thus occurring to Purchase Officer Project for finalization.

Duties of Purchase Inspector (Stock) (p.48)

4. Will maintain record of wheat damaged with reasons co-relating this with storage unit and storage point and duration of storage.

5. Will maintain register for shortages i.e., ground, transit and on local shifting.

6. Will compile DR or local shifting shortage on day to day basis. He will put up such shortage to the Purchase Officer Project for settlement. Any such shortage which is not settled shall be reported to the Zonal Office.

7. Will immediately recommend remedial measures on observations made in the process of inspection regarding storage condition, quality and quantity of grains record keeping of stocks and storage and fumigation practices.

Functions of Purchase Center (p.53)

1. Accept the fair average quality wheat tendered by the growers.

9. While accepting the wheat tendered measure should be taken that wheat offered is sound, free from infestation, had low moisture contents, free of dust, dirt and other admixture.

10. Quantity and quality of wheat accepted shall be delivered without quantitative loss or quality deterioration.

PO/PI: Incharge Purchase Center (p.55)

3. No quality or quantity loss is acceptable. Any loss on this account shall be borne jointly by the center incharge and assistant center incharge unless it is proved that the loss such occurred was beyond their control.

5. Any shortage, storage or transit loss is the responsibility of center incharge.

6. Will ensure that correct storage practices are followed and there is no damage to grain stored under this charges.

7. Will ensure that wheat/paddy is tendered at the purchase center and accepted at acceptable limits moisture contents and free from dust, dirt and other admixture.

18. Will be responsible for taking steps to safe guard the stocks from infestation by practicing the procedures and measures given in 'Field Manual on Pest Control of Stored Grain'.

Duties of Assistant Incharge Purchase Center (p.58)

3. Will be responsible for the quantity and quality of grain purchased and received at the purchase center. Authentication of the purchase and stock registers and signing on purchase bills shall be done by the

incharge. This, in any case shall not absolve him from any loss occurring to the Corporation due to negligence of the staff.

16. Will maintain fumigation record and record of infestation if any.

17. Though the purchase bills, despatch reports and transfer notes will be signed by the incharge, but as the out loading of storage unit shall be done directly under his supervision, hence will be jointly responsible for ground shortage, transit loss and quality deterioration.

Duties of Chowkidars at the Purchase Center (p.61)

5. Will fumigate the stocks as and when required.

7. Will drain stagnant water after the rain and critically examine the stores for any rain effect.

8. Will be responsible for loss or shortage of stocks placed in his custody.

Organization, Functions and Duties of Staff at the Reservoir/Godown (p.64)

1. Storage is the 'House of Grain'> Unless thee house is correct, optimization of end results in the field of procurement, storage and despatches cannot be achieved. The main objective of storage, therefore, is to accept sound grain for storage and its delivery without quality deterioration and quantity loss.

2. Organization of the storage point is drawn keeping in view its functions. Establishment at storage is divided into various compartments with the division of work and defined charter and duties. As a result the smooth and systematic functioning of storage will facilitate in achieving its ultimate goal i.e., 'Deliver the grain without quantity loss and quality deterioration'.

Functions of Reservoir/Godown/Silo (p.66)

1. Storage of grain under the ideal conditions to prevent storage losses.

2. Prevent quality deterioration by following good storage practices and pest control measures.

7. Ensure methodical grain inspection before loading the storage point, during the storage period and also at the time of unloading.

8. Take protective and curative measures in pest control and carry out fumigation so that best economic results are achieved.

Duties of Staff at the Reservoir/Godown/Silo (p.67)

Duties of Storage Officer (p.67)

4. Shall be responsible for any loss in terms of shortage, pilferage and quality deterioration.

8. Shall be responsible for following correct storage practices.

9. Shall ensure that pest control, protective and curative measures are taken.

15. No shortages, damage or quality deterioration of grain is acceptable hence any loss shall lie the responsibility of Storage Officer and Incharge Unit Storage.

Duties and Responsibilities of Unit Storage Incharges (p.70)

2. Will be responsible for the stocks under his direct charge and shall make good any quality or quantity loss during the storage of commodity.

5. Will ensure that godowns, silos or the plinths are disinfected before loading and all preventive or curative measures of pest control are taken.

11. Will aerate the godowns and ganjies as per aeration schedule.

12. Will fumigate the stocks and submit fumigation report to Project Manager, Zonal Head and Head Office.

13. Will be responsible for the quality loss and transit shortage including the transportation charges for despatches made without contractors representative for rail despatches and rejected at destination as substandard and short despatch.

Duties of Incharge Railway Station (p.74)

2. Will ensure receipt of correct quality and quantity of grain and its despatch.

Pest Control - Stored Grain (p.102)

The greatest component loss in this total is due to pests and rodents after the harvest when the crops are in store. These losses can be prevented easily in inexpensive sanitation and hygiene measures and by very economical and cost effective treatment of insecticides and rodenticides.

PASSCO's main responsibility is to accept the food grains a 'Fair Average Quality' and deliver it to recipient agency without deterioration in quality or quantity. This can only be achieved if the staff posses adequate knowledge and skill to protect the stocks from pests and rodents.

Technical Annex III-D

EXTRACTS FROM GOVERNMENT OF SIND FOOD DEPARTMENT WHEAT POLICY

1984-85

Page 10

"8. Sampling and Analysis. - No samples will be drawn from the lots offered for sale by growers. The wheat brought by them will be purchased according to specifications listed at para 6 and full payment will be made to them on the spot, through bill, on the scheduled bank specified for the locality."

Page 23

"28. Management of Stored Stock. - ... In the remarks column he will specifically indicate if any steps are necessary to check deterioration or to arrange disposal in respect to each godown."

Page 27

"45. Sale of Wheat from Government Reserve. - ... The wheat will be issued to the purchaser ex-Provincial Reserve Godown on ten percent weighment. He will, however, have an option to demand cent (100) percent weighment. The expenses in both the cases shall be borne by him."

Page 59

"(8) Any sign of heating in the bags means danger and is due to either wet grain being put into stores or heavy insect attack. Immediate disposal is necessary."

Page 59

"(f) Removal from Stores - (2) to check any loss or increase in weight during storage a percentage of bags should be weighed before dispatch."

"(3) Allocation from godowns should normally be in chronological order of receipt, but if any stock show signs of insect danger it should be recommended for immediate issue, no matter how short the storage period has been. This is most important and should receive special attention to avoid wastage and cross infestation. Where any particular stock is more damaged than the rest, this should be issued first."

Page 63

In case of milling district, priorities should be fixed in writing for the disposal of infested stocks..."

Technical Annex III-E

EXTRACTS FROM SALIENT FEATURES OF THE WHEAT PROCUREMENT POLICY 1986-87

GOVERNMENT OF THE PUNJAB FOOD DEPARTMENT

1. Procurement of Wheat during 1986-87

Page 2

"Government desires that wheat procurement operations should be free from all malpractices and there should be no complaint especially about taking of excess weight from the growers/sellers. The growers should be provided all the facilities as admissible in the Wheat Procurement Scheme. The purchase of fair average quality wheat should be ensured. Once the stocks received from temporary purchase centers at P.R. Centers are accepted for storage, the incharge of P.R. Center will be solely responsible for quality and weight of stock and no plea otherwise will be acceptable."

"At the storage centers where old wheat is in storage, new staff should be posted for purchase, receipt and storage of 1986-87 wheat in order to eliminate chances of misappropriation/embezzlement and making up the shortage, if any, by the staff already posted there which will continue to be the custodian of old wheat till its clearance."

2. Salient Features of the Wheat Procurement Policy for 1986-87

Page 1

"(4) ... During the wheat procurement operations, the most common complaint is with regard to the taking of wheat in excess of the weight prescribed for each bag. This practice is highly irregular ..."

"(5) Growers/Traders, Arthies and Co-operative Societies who tender wheat would be paid full price at the spot through branches of the Scheduled Banks/Booths immediately on delivery of the stocks conforming to F.A.Q. The stocks tendered by growers and accepted for purchase will not be subject to quality deductions. The quality deductions will, however, be recovered from the Arthies/Traders/Co-operative Societies on assessment by the Foodgrains Laboratories."

"(6) The stocks tendered at the Purchase Center must conform to the prescribed specification and should be free from dirt/dust/ghundy etc."

"(14) Once the stocks received from temporary Purchase Center P.R. Center are accepted for storage, the Incharge P.R. Center would be solely responsible for quality and weight of stock. He would, therefore, accept stocks on his full satisfaction. No plea regarding the stocks short in weight or below specification would be acceptable at any stage thereafter."

"(21) Supervisory Committee ... the importance of their role in eliminating mal-practices in wheat procurement, especially the taking of excess wheat by the officials of Food Department.

Technical Annex III-F

EXTRACTS ON NO LOSS POLICY, FAQ, HANDLING AND STORAGE PRACTICES, OTHER QUALITY ISSUES

The enforcement of the FAQ and No Loss Policy is based on the regulations issued by PASSCO and the Provincial Food Departments in their respective operations manuals and annual wheat procurement policy guidelines. While both the PASSCO and provincial wheat policy guidelines and manuals contain sound advice regarding wheat handling, storage and facility management, their provisions are often contradictory.

The PASSCO's field manual clearly states on several occasions that "no quantity or quality loss is acceptable". The provincial wheat policy guidelines are somewhat more circumspect about stating the same principle. The Punjab Food Department Wheat Policy states that "once the stocks are received ... and accepted for storage... no plea regarding the stocks short in weight or below specification would be acceptable at any stage thereafter". In Sind, "special attention is given to avoid wastage"

To a degree, these very same guidelines contain clauses that prevent the producers and procurement center and godown personnel from adhering to the regulations designed to enforce the FAQ and No Loss Policy. Charging a buyer for weighing his whole purchase rather than sampling bag weights (Sind) would discourage questioning the weights used in billing. That "no samples will be drawn from the lots offered for sale by growers (Sind)" or that "the stocks tendered by growers and accepted for purchase will not be subject to quality deductions (Punjab)" signals permission to accept all lots offered without a rudimentary inspection. Also, statements such as "to check any loss or increase in weight during storage, a percentage of the bags should be weighed before dispatch (Sind)" recognize that changes in weight do occur, but the regulations are silent on who should claim increases in weight while the godown workers are clearly held responsible for losses.

Coping with the No loss Policy

The following are excerpts from different studies which have documented how the government procurement, storage, and distribution systems have "rationalized" malpractices in order to cope with FAQ and No Loss Policy, and the producers, middlemen, and grain millers response.

Foodgrain Storage and Processing Study, Final Report, Volume I, Agroprogress Kienbaum International GmbH, Bonn, West Germany, 1987.

"The efficient operation of public wheat storage facilities is hampered by technical constraints as well as by management problems. A serious problem for all storage depots is the official regulation, that no losses are permitted. The same quantity of grain, which is received, must be dispatched, even if unavoidable weight losses occur through demoisturization. The "no loss" regulation leads to malpractices, which are detrimental to efficient grain management. Impurities are mixed into grain to make-up for weight losses.

Such impurities cause high wear and tear in mechanical conveying equipment and have detrimental effects on grain quality."

"The fact, that wheat generally is stored without precleaning, leads to quality control problems, especially if it is stored over longer periods." (Page 48)

"Silos, Non-use of precleaning sieve: Precleaning sieves are bypassed to "avoid losses". The wheat is stored with all impurities of dust, straw, insects and coarse admixtures. This causes heavy wear and tear in equipment and makes quality control difficult. Cooling of grain by turning over is impractical because of high wear."

"No laboratory: proper quality control is not possible".
(Page 49)

"Spillage: Since in the public sector the no-loss-rule applies, there is no official recording of spillage available. Furthermore, spillage may to some extent also be associated to other malpractices like pilferage and admixture of foreign matters, in order to make up for weight shortages."

"Weight reduction due to moisture losses (shrinkage) of stored grain was found to be mentioned as one of the most frequent causes for (accounting) losses, by the store-staff. Reduction of moisture content can not be considered as a food loss in the strict sense, and even when accounting for shortages, shrinkage must be seen as an argument of only limited value."

"Under practical conditions, shrinkage is of significant relevance in Pakistan only when imported wheat with high moisture content of 13-14%, or indigenous wheat is transported during monsoon from the coastal areas of Sind province to the arid climate conditions of Baluchistan. If the grain is then further stored in Quetta for 4-6 months it may lose 2% moisture and subsequently 2.3 % in weight." (Page 71)

"The improper application of basically correct and adequate instructions, has multiple reasons... counterproductive administrative regulations (no-loss-rule)... Up to now, as a consequence of the no-loss regulation, the efforts in storage are almost exclusively centered on loss-control and here especially on insect pests." (Page 78)

Grain Quality, Grain Testing and Quality Control Study, Agroprogress Kienbaum, Bonn, West Germany, 1985

"The grain purchasing organizations rely upon visual inspection at procurement points to determine the quality of wheat offered for purchase. This is not a precise method and will not accurately and consistently determine the categories of defects. At present the Punjab Food Department has a tolerance limit of 0.5% of dirt, dust and non-edible matter and rejects wheat containing over 1%, calculated by weight. The analysis of data from 100 procurement samples taken at random from each of the three Regions gave a mean of 0.35% contamination. This appeared to be an under-estimation in that mechanical sieving removed 1.6% and samples issued from godowns averaged 1.91%. This

higher figure is supported by evidence applied by PASSCO which used mechanical sieves to clean about 250,000 tones of wheat for export during the period 1983-85. These removed an average of 1.5% of dirt and left a residual 0.3% to 0.2%." (Page 5)

"Moisture content: This was a subject which provided considerable comment from store staff who claimed that a weight loss occurred due to stacks drying out after the end of the summer rains. The consultants were unable to obtain information of any investigation carried out to establish changes in moisture content during long-term storage (say one year)". (Page 11)

"It was frequently noticed that when godowns were being worked, a considerable amount of spillage occurred but this was not measured... it was considered that rebagging spillage provided the only in-store opportunity for soil to be deliberately added to increase bag weight..." (Page 12)

"Wheat is purchased by the procurement agencies on a "Fair Average Quality" basis and this is determined by visual inspection. The term "FAQ" is generally taken to mean the average quality of a commodity in a particular cropping year and this standard may change from year to year... Both the Pujab and Sind retain procurement standards based on percentage by weight of defective grains or adulterants. These standards were formulated many years ago for reasons which cannot longer be verified." (Page 15)

"It is not possible, by visual examination of a sample of wheat, to determine if it exceeds the various tolerances and rejection limits... judgement is necessarily subjective... In several instances whole bags of wheat were selected at random from PRC godowns and mechanically sieved. In all bags the dirt content was above the tolerance and frequently above the reject levels." (Page 16)

The present, very subjective, procedure for assessing quality... does not determine the actual dirt content, shrivelled or damaged grains or the degree of insect infestation, nor will it determined if the grain is suitable for long-term storage, because no attempt is made to measure moisture content. There may be accounting losses due to wheat drying out after purchase, or gains due to increase in moisture content, depending on the m.c. at the time of issue from Government godowns." (Page 17)

"The main cause for concern must be in the variation of separable inert material content... If the true figure at procurement approximates to 2 per cent, the value of inedible material in the 1,300,000 tones 1984/85 of wheat purchased by the Pujab FD (at a support price of Rs. 1,750 per tone) was Rs. 45,500,000 and not the Rs. 7,962,000, it should have been at the 0.35 per cent level." (Page 19)

"There is a considerable body of opinion that lower than actual weights are recorded at PC's and that to some extent this offsets in-store losses." (Page 21)

"The findings of the team indicate that procurement sample analysis data underestimates dust/dirt and non-edible matter content and this was

corroborated by PASSCO who prepared 250,000 tones for export to Iran and removed some 1.5% dirt leaving a residual 0.2-0.3%. As purchased, this wheat should have been above the Punjab Food Department rejection limit." (Page 30)

"... the change in moisture content of wheat from procurement to issue from Government godowns - a subject surrounded by considerable confusion, much opinion and few facts." (Page 53)

<u>A study of Problems Associated with Procurement, Storage and Distribution of Wheat</u>, Report Submitted to The Prime Minister of Pakistan, May 1976, MICAS Associates, Karachi, Pakistan.

"There is a steady flow of complaints about bribes, which are now a matter of established custom, to the food officials, short-weight and tampering with the quality of wheat. It is generally believed that the farmer supplies a higher quality than FAQ and that at some stage dust, weed seeds, and other foreign matter, and even damaged wheat from the old stocks, is added before making deliveries to the purchase centre. There is also allegations that influence, if not pressure, is exercised on food officials to accept wheat which is not up to the prescribed standard." (Page 17)

"There are reports that considerable amounts of wheat gets damaged because of improper storage facilities and that the Food officials in order to get rid of such stocks pass them to the mills and on to the consumer... There are complaints that at the milling stage the quality further deteriorates. The moisture content is increased to make up for the short weight... From the flour mills there are complaints that they receive short weights from the Food Department and a large proportion of the wheat is not of the standard quality. .. The transportation of wheat also leads to a number of malpractices... of a large pilferage... In the distribution of wheat to the consumer there are many allegations... complaints about the quality of atta... bogus ration cards." (Page 18)

"The opinions and apprehensions expressed by the small farmer regarding on-the-spot payment and dishonesty at the purchase centre show that these are real factors in his choice for selling to the Arthi."

"Arthi... purchases better quality from the farmer, mixes it with lower quality and brings the supplies to the standards acceptable to the officials at the purchase centre." (Page 31)

"The complaints (of the Arthis) were against sampling procedure and under weighment... When a particular lot is brought to the purchase centre, they pick up bags, that by visual observation, seemed to weigh less. This is the sample which is then used for calculating the average weight of bags. The Food Officials explained that it was necessary for them to do this. They conceded that this practice gives them more weight than that is being recorded, but stated that since no allowances are made for transportation losses and damage, they found the practice convenient in their own accounting procedures. The excess amount thus procured is then used for adjusting any losses which might occur without bringing the transaction on to the account books."

"Of the respondents from the Punjab 41% stated that they mixed poor quality with better quality wheat before selling to the Government. The discretionary powers of acceptance or rejection exercised by Food Officials become invitation to malpractices." (Page 32)

"When a question was put to the Arthis about their understanding of FAQ, in Sind 97% were unable to describe what FAQ conveyed to them... In the Punjab 50 % gave no answer, 30% stated that it was a method of making deductions whole 35% stated that it allows 8% impurities."
"The Arthis have stated that they buy wheat which is above the FAQ level from the farmer and bring it down to the level acceptable to the purchase centre by adding impurities, etc.

"Our survey has clearly shown that a flat adoption of FAQ has led to a large number of malpractices." (Page 35)

"In economic terms these malpractices are rational responses of the farmers and the Arthi to an irrational standard sought to be maintained by the Government." (Page 36)

"To sum up, the FAQ at present is primarily seen as a licence for having 7% to 8% mixture in the wheat supplied to Government."

"Visual observation for judging quality of wheat leads to abuses." (Page 36)

"In the interviews with storage officers 21% stated that the quantity of wheat received was not always in accordance with the amount showed on the despatch order. In respect of quality 83% stated that wheat received was below FAQ standards. Of the respondents 58% relied wholly on visual observation to judge the quality of incoming wheat, only 38% used laboratory tests."

"Of the respondents 54% stated that in storage no insect damage takes place... The total storage loss due to these causes (insects, rodents, moisture) comes to 1.25%."

"The reason for hesitation in admitting higher losses was primarily related to an accounting problem. The Food Department does not allow any margin for storage losses. The account books have, as far as possible, to be shown as balanced. The wheat receipts are to equal the wheat issue. If a shortage occurs, this is passed on to the millers in shortweight. The miller is however also allowed to keep his accounts in shape. He can pass on the shortage on to the ration depot holders, or make up for the loss by selling a part of the atta in the open market or through higher extraction of suji and maida during milling. The ration depot holder has the same choices. The Food Department has to acquiesce in these practices in order to cover up the shortweight supplied to the miller." ((Page 52))

"The argument of the Food Department and private traders was that since the market accepts wheat which is not clean they had no reason to have the wheat cleaned before storage. A rational operation could not be undertaken because of an irrational grading criteria." (Page 55)

"The millers tended to have a poor opinion about the quality of wheat supplied by Government. A majority (54%) millers stated that the wheat was not according to FAQ."

"Of those interviewed 57% were dissatisfied and complained that at Government godowns weighing is always less." (Page 63)

"The majority from Punjab (64%) and NWFP (63%) stated that the problems in milling are low quality of wheat supplied by the government. (Page 63).

Extracts from Interviews with Procurement Officials and Arthis

"Wheat gets infested due to lack of staff and improper storage facilities. Large quantities of the wheat gets damaged before arrangements are made to fumigate the stock. We are held responsible for this loss which is covered from our salaries."

"Our biggest problem is that wheat losses its weight after some time. This causes shrinkage in weight which we have to make up somehow. If this is not done, the loss is recovered from our salaries."

"Moreover when wheat gets infested, the loss is recovered from us. The Government should allow us a certain percentage of loss due to shortage."

"Wheat which is stored at the Procurement Centre is normally disposed of after about a year. During this period, storage losses occur which are charged to us. In addition to this, losses also occur in rebagging, transportation and at the Railway Station. These losses are substantial and are recovered from our salaries. These are the reasons which incline us toward dishonesty."

"Arthis supply the full quantity at the rail-head but when the wheat reaches its destination, a wire is normally received by us stating that either the quantity is less or the wheat is damaged. The Food Department Officials the accuse us of supplying poor quality wheat."

"This year at the Centre, Arthis did large scale mixing. The wheat was mixed with sand and water. Local food grain dealers having witnessed this, started following the practice... We get poor quality accepted by the Procurement Official by paying a small cash amount." (Page 94)

Godown Rehabilitation, Recurrent Cost Analysis and management Audit of Public Sector Grain Storage, Experience Incorporated, Minneapolis Minnesota, November 1986.

"First, the current "no loss" policy which facility managers are forced to operate under was found to contribute to "outrageous adulteration" practices which place the health of consumers in jeopardy. Even the most sophisticated and technologically advanced grain storage system recognizes and accepts reasonable weight losses due to normal respiration and moisture losses." Page (xv)

"The wheat in stock was tested for moisture content, and the results were averaged by month for the period under study. In most locations, moisture

content of the wheat did not exhibit a pattern of either a large increase or decrease over time."
(Page 7)

"Operation and management problems arose from observed structural deficiencies, and were also affected by official regulations that "no losses' in storage are allowed. It is believed that this regulation led to malpractice and poor storage practices through-out the public storage sector.

"Wheat entering HTG's was generally stored without precleaning thus leading to quality control problems. The fumigation practices observed were believed to be inefficient and ineffective due to leakage around doors and windows in the buildings and fumigation underdosing." (Page 11)

"Specific instructions are given as to housekeeping and treatment of stores by type/ownership of godowns, including inspection and fumigation of stocks. It is in these regulations that the "no loss" operating practice has been developed. Four specific regulations make strong references to losses in storage and appear to emphasize the concept.

1)".....all possible efforts to save stocks from deterioration until their final disposal,"

2)"All precautions should be taken to avoid losses at time of clearance,"

3)"Efforts should be made to avoid losses in Government stocks,"

4).....shortages, if any, should be forwarded to Regional Offices.... after an enquiry by DFC concerned."

It is not difficult, in view of these regulations, to understand how one who does not fully understand the nature and need for such regulations might interpret them to mean "no loss" and operate accordingly. He would do all he could to insure that disposal from stocks under his control equalled receipts." (Page 29)

"With the implied "no loss" operating characteristic, it appears that some adulterative practices are required to equate the receipt/disbursement tonnages in view of the data which demonstrates that weight loss occurs in storage." (Page 30)

"All the respondents reported that they weighed samples of both receipts and shipments at their respective storage centers. This is likely to be true for most storage centers throughout Pakistan due to the "no loss" regulation. All reported they weighed at least 10 per cent of the incoming lots of wheat; however, the respondents reported they weighed an average of almost 48 per cent of the outgoing lots. The reported range of weighing of outgoing lots was from 10 to 100 per cent." (Page 45)

"Almost 49 per cent of the storage officers interviewed, reported that neither they, nor anyone under their supervision, had received any formal training in grain storage management. Of the 51 per cent that had received training, such training addressed records, policy and regulation issues." (Page 50)

TECHNICAL ANNEX IV.

A. Average Percentage of Various Abnormalities
B. Grading of Wheat Samples in Pakistan during 1984-85

AVERAGE PERCENTAGE OF VARIOUS ABNORMALITIES IN THE WHEAT GRAINS OF SOME COMMERCIAL VARIETIES COLLECTED FROM THRESHING FLOORS IN APRIL/MAY 1983 SIND AND PUNJAB

		PERCENTAGE OF GRAINS						
Variety	Number Samples	Shrivelled	Black Point	Other Food Grains	Weeviled	Broken	Sprouted	Suautted
SA-42	1	4.71	6.16	0.00	0.00	0.36	0.36	0.00
Pavan	8	10.87	6.91	0.18	0.03	2.51	0.08	0.00
C-591	1	14.17	1.39	0.28	0.00	0.55	0.00	0.00
WL-711	6	7.44	6.26	0.33	0.06	1.38	0.11	0.32
Pak-81	5	12.45	10.48	0.87	0.04	4.65	4.48	0.22
Unknown	3	8.32	3.27	1.09	0.06	0.65	0.00	5,28
Blue Silver	6	7.15	8.50	1.52	0.08	1.30	0.00	0.00
Maxipak	4	8.77	7.84	2.68	0.32	3.74	1.75	0.00
L-73	10	7.02	9.16	3.48	0.10	0.81	4.92	0.14
Sonalika	9	9.95	6.35	3.79	0.23	1.86	1.02	0.00
Mixed	8	9.06	8.26	3.98	0.25	2.22	0.72	0.49
Yakora	19	12.23	7.40	4.59	0.15	2.56	0.88	0.03
Sandle	1	15.96	1.06	12.23	0.27	0.27	0.27	0.00
Avg./Total	80	9.35	6.83	1.90	0.11	1.88	1.19	0.54
Std. Dev.		2.59	2.38	1.63	0.10	1.27	1.65	1.44

Samples that would be rejected under PASSCO FAQ for:

	No.	Pct.
Dirt/dust/inedible materials	40	49.4%
Shrivelled	81	100.0%
Other food grains	1	1.2%
Weeviled 1/	80	98.8%
Moisture 2/	81	100.0%

1/ Weeviled grain accepted after August
Reject limits
Sept./Oct. 1.0%, Nov./Dec. 2.0%, Jan onward 3.0%.

2/ Moisture meter used was inaccurate.
Most samples should have been within limits.

Technical Annex IV-B

GRADING OF WHEAT SAMPLES IN PAKISTAN DURING 1984-85

	At Intake				At Delivery			
Punjab	Foreign Matter	O. Food Grains	Broken & Shrivel	Insect Damage	Foreign Matter	O. Food Grains	Broken & Shrivel	Insect Damage
A	22.5	83.7	47.5	60.8	18.7	79.2	41.3	40.6
B	13.8	12.9	27.9	26.4	14.6	14.1	25.8	43.4
C	0	0	14.1	0	0	0	16.9	0
D	63.7	3.3	10.4	0	66.7	6.5	16.2	0
Rawalpindi								
A	12.8	67.4	73.9	70.7	8.5	73.5	65.8	56.8
B	19.6	21.7	8.7	14.1	24.7	22.2	16.2	11.9
C	6.5	8.6	6.5	1.1	7.7	0.9	4.2	3.8
D	60.9	2.2	10.9	20.1	0	0	0	21.5
NWFP								
A	5.8	97.3	58.7	80.5	4.6	97.7	56.2	65.4
B	15.0	2.4	18.8	4.1	19.0	2.3	19.3	3.9
C	0	0	13.0	0	0	0	9.5	0
D	79.24	0.3	9.6	11.1	76.5	0	15.0	0
Baluchistan								
A	0.1	86.3	98.6	76.4	39.3	92.4	98.2	86.8
B	20.2	12.8	0.9	1.3	18.3	5.4	1.3	3.2
C	0	0	0.4	0	0	1.3	0.5	0
D	39.6	0.9	0	22.3	42.4	0.9	0	9.8
Sind								
A	0	100.0	88.5	100.0	2.0	95.9	89.8	36.7
B	9.3	0	6.9	0	8.6	4.1	4.1	10.2
C	30.2	0	4.6	0	18.4	0	0	0
D	0	0	0	0	71.4	0	6.1	2.1
Karachi								
A	0	97.8	0	48.9	0	100.0	2.0	0
B	6.7	2.2	2.2	0	0	0	16.3	0
C	77.8	0	0	0	48.9	0	0	0
D	15.6	0	97.8	0	51.1	0	77.6	8.2

1/ 12.7% of sample in the Punjab, 12.1% in Rawalpindi, 14.0% in NWFP, 51.1% in Karachi were out of grade due to insects at intake.

2/ 15.9% of sample in Punjab, 30.7% in NWFP, 51.0% in Sind, 91.0% in Karachi were out of grade due to insects at delivery.

TECHNICAL ANNEX V.

A. Grading Standards - Based on specification of Food Departments
B. Conversion of 100 Kilograms of Grains as Purchased to Quantity of Grain Stored at 0.5% FM, 10% Moisture Content

Technical Annex V-A

GRADING STANDARDS - BASED ON SPECIFICATION OF FOOD DEPARTMENTS OF SIND AND PUNJAB

FACTOR	GRADE A	GRADE B	GRADE C	GRADE D
FOREIGN MATTER	Max. 0.5%	Max. 1.0%	Max. 1.0% (SIND Max. 2.0%)	Above 1% SIND-Above 2%
OTHER FOOD GRAINS	Max. 3.0%	Max. 5.0%	Max. 5.0%	Above 5%
DAMAGED/ SHRIVELLED GRAINS	Max. 3.0%	Max. 4.0%	Max. 5.0%	Above 5%
INSECT DAMAGED GRAINS NEW CROP TILL AUGUST	NIL	NIL	NIL	NIL
SEPT. TO OCT.	Max. 0.5%	Max. 1.0%	Max. 1.0%	Max. 1.0%
NOV. TO DEC.	Max. 1.0%	Max. 2.0%	Max. 2.0%	Max. 2.0%
JANUARY ONWARDS	Max. 1.5%	Max. 3.0%	Max. 3.0%	Max. 3.0%

CONVERSION OF 100 KILOGRAMS OF GRAINS AS PURCHASED TO QUANTITY OF GRAIN STORED AT 0.5% FM, 10% MOISTURE CONTENT

GRAIN AS PURCHASED TO BE STORED @ % IMP. 0.5% (100 KG.)	% HUM 10.0%	QUANTITY REDUCTION IMPURITY (KGS.) 1/	HUMIDITY (KGS.) 2/	TOTAL WEIGHT LOSS (KGS.) 3/	NET WEIGHT AFTER CLEANING & DRYING (KGS.)	PURCHASE PRICE PER 100 KG @ RP./100 KG 200.00	QUANTITY TO BUY TO STORE 100 KGS. @ .5%I. 10%H. (KGS.)
7.0%	13.0%	6.53	3.12	9.65	90.35	180.70	110.7
7.0%	12.0%	6.53	2.08	8.61	91.39	182.78	109.4
7.0%	11.0%	6.53	1.04	7.57	92.43	184.86	108.2
7.0%	10.0%	6.53	0.00	6.53	93.47	186.93	107.0
7.0%	9.0%	6.53	-1.04	5.49	94.51	189.01	105.8
7.0%	8.0%	6.53	-2.08	4.46	95.54	191.09	104.7
6.0%	13.0%	5.53	3.15	8.68	91.32	182.65	109.5
6.0%	12.0%	5.53	2.10	7.63	92.37	184.75	108.3
6.0%	11.0%	5.53	1.05	6.58	93.42	186.85	107.0
6.0%	10.0%	5.53	0.00	5.53	94.47	188.94	105.9
6.0%	9.0%	5.53	-1.05	4.48	95.52	191.04	104.7
6.0%	8.0%	5.53	-2.10	3.43	96.57	193.14	103.5
5.0%	13.0%	4.52	3.18	7.71	92.29	184.59	108.3
5.0%	12.0%	4.52	2.12	6.64	93.36	186.71	107.1
5.0%	11.0%	4.52	1.06	5.58	94.42	188.83	105.9
5.0%	10.0%	4.52	0.00	4.52	95.48	190.95	104.7
5.0%	9.0%	4.52	-1.06	3.46	96.54	193.08	103.6
5.0%	8.0%	4.52	-2.12	2.40	97.60	195.20	102.5
4.0%	13.0%	3.52	3.22	6.73	93.27	186.53	107.2
4.0%	12.0%	3.52	2.14	5.66	94.34	188.68	106.0
4.0%	11.0%	3.52	1.07	4.59	95.41	190.82	104.8
4.0%	10.0%	3.52	0.00	3.52	96.48	192.96	103.6
4.0%	9.0%	3.52	-1.07	2.45	97.55	195.11	102.5
4.0%	8.0%	3.52	-2.14	1.37	98.63	197.25	101.4
4.0%	7.0%	3.52	-3.22	0.30	99.70	199.40	100.3
3.0%	13.0%	2.51	3.25	5.76	94.24	188.48	106.1
3.0%	12.0%	2.51	2.17	4.68	95.32	190.64	104.9
3.0%	11.0%	2.51	1.08	3.60	96.40	192.81	103.7
3.0%	10.0%	2.51	0.00	2.51	97.49	194.97	102.6
3.0%	9.0%	2.51	-1.08	1.43	98.57	197.14	101.5
3.0%	8.0%	2.51	-2.17	0.35	99.65	199.31	100.3
3.0%	7.0%	2.51	-3.25	-0.74	100.74	201.47	99.3
2.0%	13.0%	1.51	3.28	4.79	95.21	190.42	105.0
2.0%	12.0%	1.51	2.19	3.70	96.30	192.61	103.8
2.0%	11.0%	1.51	1.09	2.60	97.40	194.80	102.7
2.0%	10.0%	1.51	0.00	1.51	98.49	196.98	101.5
2.0%	9.0%	1.51	-1.09	0.41	99.59	199.17	100.4
2.0%	8.0%	1.51	-2.19	-0.68	100.68	201.36	99.3
1.0%	13.0%	0.50	3.32	3.82	96.18	192.36	104.0
1.0%	12.0%	0.50	2.21	2.71	97.29	194.57	102.8
1.0%	11.0%	0.50	1.11	1.61	98.39	196.78	101.6
1.0%	10.0%	0.50	0.00	0.50	99.50	198.99	100.5
1.0%	9.0%	0.50	-1.11	-0.60	100.60	201.21	99.4
1.0%	8.0%	0.50	-2.21	-1.71	101.71	203.42	98.3
0.5%	13.0%	0.00	3.33	3.33	96.67	193.33	103.4
0.5%	12.0%	0.00	2.22	2.22	97.78	195.56	102.3
0.5%	11.0%	0.00	1.11	1.11	98.89	197.78	101.1
0.5%	10.0%	0.00	0.00	0.00	100.00	200.00	100.0
0.5%	9.0%	0.00	-1.11	-1.11	101.11	202.22	98.9
0.5%	8.0%	0.00	-2.22	-2.22	102.22	204.44	97.8

1/ ((INT. IMP. % - FINAL IMP. %) / (1.00 - FINAL IMP. %) X 100
2/ ((INT. HUM. % - FINAL IMP. %) / (1.00 - FINAL HUM. %) X 100 (100 - IMP. REMOVED KG.)
3/ IMPURITY REMOVED KG. + HUMIDITY REMOVED KG.

CONVERSION OF 100 KILOGRAMS OF GRAINS AS PURCHASED
TO QUANTITY OF GRAIN STORED AT 0.5% FM, 10% MOISTURE CONTENT

GRAIN AS PURCHASED TO BE STORED @ % IMP. 1.0% (100 KG.)	% HUM 10.0%	QUANTITY REDUCTION IMPURITY (KGS.) 1/	HUMIDITY (KGS.) 2/	TOTAL WEIGHT LOSS (KGS.) 3/	NET WEIGHT AFTER CLEANING & DRYING (KGS.)	PURCHASE PRICE PER 100 KG @ RP./100 KG 200.00	QUANTITY TO BUY TO STORE 100 KGS. @ .1%I. 10%H. (KGS.)
7.0%	13.0%	6.06	3.13	9.19	90.81	181.62	110.1
7.0%	12.0%	6.06	2.09	8.15	91.85	183.70	108.9
7.0%	11.0%	6.06	1.04	7.10	92.90	185.79	107.6
7.0%	10.0%	6.06	0.00	6.06	93.94	187.88	106.5
7.0%	9.0%	6.06	-1.04	5.02	94.98	189.97	105.3
7.0%	8.0%	6.06	-2.09	3.97	96.03	192.05	104.1
6.0%	13.0%	5.05	3.16	8.22	91.78	183.57	109.0
6.0%	12.0%	5.05	2.11	7.16	92.84	185.68	107.7
6.0%	11.0%	5.05	1.05	6.11	93.89	187.79	106.5
6.0%	10.0%	5.05	0.00	5.05	94.95	189.90	105.3
6.0%	9.0%	5.05	-1.05	4.00	96.00	192.01	104.2
6.0%	8.0%	5.05	-2.11	2.94	97.06	194.12	103.0
5.0%	13.0%	4.04	3.20	7.24	92.76	184.59	107.8
5.0%	12.0%	4.04	2.13	6.17	93.83	186.71	106.6
5.0%	11.0%	4.04	1.07	5.11	94.89	188.83	105.4
5.0%	10.0%	4.04	0.00	4.04	95.96	190.95	104.2
5.0%	9.0%	4.04	-1.07	2.97	97.03	193.08	103.1
5.0%	8.0%	4.04	-2.13	1.91	98.09	195.20	101.9
4.0%	13.0%	3.03	3.23	6.26	93.74	186.53	106.7
4.0%	12.0%	3.03	2.15	5.19	94.81	188.68	105.5
4.0%	11.0%	3.03	1.08	4.11	95.89	190.82	104.3
4.0%	10.0%	3.03	0.00	3.03	96.97	192.96	103.1
4.0%	9.0%	3.03	-1.08	1.95	98.05	195.11	102.0
4.0%	8.0%	3.03	-2.15	0.88	99.12	197.25	100.9
4.0%	7.0%	3.03	-3.23	-0.20	100.20	199.40	99.8
3.0%	13.0%	2.02	3.27	5.29	94.71	189.43	105.6
3.0%	12.0%	2.02	2.18	4.20	95.80	191.60	104.4
3.0%	11.0%	2.02	1.09	3.11	96.89	193.78	103.2
3.0%	10.0%	2.02	0.00	2.02	97.98	195.96	102.1
3.0%	9.0%	2.02	-1.09	0.93	99.07	198.14	100.9
3.0%	8.0%	2.02	-2.18	-0.16	100.16	200.31	99.8
3.0%	7.0%	2.02	-3.27	-1.25	100.25	202.49	98.8
2.0%	13.0%	1.01	3.30	4.31	95.69	191.38	104.5
2.0%	12.0%	1.01	2.20	3.21	96.79	193.58	103.3
2.0%	11.0%	1.01	1.10	2.11	97.89	195.78	102.2
2.0%	10.0%	1.01	0.00	1.01	98.99	197.98	101.0
2.0%	9.0%	1.01	-1.10	-0.09	100.09	200.18	99.9
2.0%	8.0%	1.01	-2.20	-1.19	101.19	202.38	98.8
1.0%	13.0%	0.00	3.33	3.33	96.67	193.33	103.4
1.0%	12.0%	0.00	2.22	2.22	97.78	195.56	102.3
1.0%	11.0%	0.00	1.11	1.11	98.89	197.78	101.1
1.0%	10.0%	0.00	0.00	0.00	100.00	200.00	100.0
1.0%	9.0%	0.00	-1.11	-1.11	101.11	202.22	98.9
1.0%	8.0%	0.00	-2.22	-2.22	102.22	204.44	97.8
0.5%	13.0%	-0.51	3.35	2.85	97.15	193.31	102.9
0.5%	12.0%	-0.51	2.23	1.73	98.27	196.54	101.8
0.5%	11.0%	-0.51	1.12	0.61	99.39	198.78	100.6
0.5%	10.0%	-0.51	0.00	-0.51	100.51	201.01	99.5
0.5%	9.0%	-0.51	-1.12	-1.62	101.62	203.24	98.4
0.5%	8.0%	-0.51	-2.23	-2.74	102.74	205.48	97.3

1/ ((INT. IMP. % - FINAL IMP. %) / (1.00 - FINAL IMP. %) X 100
2/ ((INT. HUM. % - FINAL IMP. %) / (1.00 - FINAL HUM. %) X 100 (100 - IMP. REMOVED KG.)
3/ IMPURITY REMOVED KG. + HUMIDITY REMOVED KG.

CONVERSION OF 100 KILOGRAMS OF GRAINS AS PURCHASED
TO QUANTITY OF GRAIN STORED AT 2.0% FM, 10% MOISTURE CONTENT

GRAIN AS PURCHASED TO BE STORED @ % IMP. 2.0% (100 KG.)	% HUM 10.0%	QUANTITY REDUCTION IMPURITY (KGS.) 1/	HUMIDITY (KGS.) 2/	TOTAL WEIGHT LOSS (KGS.) 3/	NET WEIGHT AFTER CLEANING & DRYING (KGS.)	PURCHASE PRICE PER 100 KG @ RP./100 KG 200.00	QUANTITY TO BUY TO STORE 100 KGS. @ 2.0%I. 10%H. (KGS.)
7.0%	13.0%	5.10	3.16	8.27	91.73	183.47	109.0
7.0%	12.0%	5.10	2.11	7.21	92.79	185.58	107.8
7.0%	11.0%	5.10	1.05	6.16	93.84	187.69	106.6
7.0%	10.0%	5.10	0.00	5.10	94.90	189.80	105.4
7.0%	9.0%	5.10	-1.05	4.05	95.95	191.90	104.2
7.0%	8.0%	5.10	-2.11	2.99	97.01	194.01	103.1
6.0%	13.0%	4.08	3.20	7.28	92.72	185.44	107.9
6.0%	12.0%	4.08	2.13	6.21	93.79	187.57	106.6
6.0%	11.0%	4.08	1.07	5.15	94.85	189.71	105.4
6.0%	10.0%	4.08	0.00	4.08	95.92	191.84	104.3
6.0%	9.0%	4.08	-1.07	3.02	96.98	193.97	103.1
6.0%	8.0%	4.08	-2.13	1.95	98.05	196.10	102.0
5.0%	13.0%	3.06	3.23	6.29	93.71	187.41	106.7
5.0%	12.0%	3.06	2.15	5.22	94.78	189.57	105.5
5.0%	11.0%	3.06	1.08	4.14	95.86	191.72	104.3
5.0%	10.0%	3.06	0.00	3.06	96.94	193.88	103.2
5.0%	9.0%	3.06	-1.08	1.98	98.02	196.03	102.0
5.0%	8.0%	3.06	-2.15	0.91	99.09	198.19	100.9
4.0%	13.0%	2.04	3.27	5.31	94.69	189.39	105.6
4.0%	12.0%	2.04	2.18	4.22	95.78	191.56	104.4
4.0%	11.0%	2.04	1.09	3.13	96.87	193.74	103.2
4.0%	10.0%	2.04	0.00	2.04	97.96	195.92	102.1
4.0%	9.0%	2.04	-1.09	0.95	99.05	198.10	101.0
4.0%	8.0%	2.04	-2.18	-0.14	100.14	200.27	99.9
4.0%	7.0%	2.04	-3.27	-1.22	101.22	202.45	98.8
3.0%	13.0%	1.02	3.30	4.32	95.68	191.36	104.5
3.0%	12.0%	1.02	2.20	3.22	96.78	193.56	103.3
3.0%	11.0%	1.02	1.10	2.12	97.88	195.76	102.2
3.0%	10.0%	1.02	0.00	1.02	98.98	197.96	101.0
3.0%	9.0%	1.02	-1.10	-0.08	100.08	200.16	99.9
3.0%	8.0%	1.02	-2.20	-1.18	101.18	202.36	98.8
3.0%	7.0%	1.02	-3.30	-2.28	102.28	204.56	97.8
2.0%	13.0%	0.00	3.33	3.33	96.67	193.33	103.4
2.0%	12.0%	0.00	2.22	2.22	97.78	195.56	102.3
2.0%	11.0%	0.00	1.11	1.11	98.89	197.78	101.2
2.0%	10.0%	0.00	0.00	0.00	100.00	200.00	100.0
2.0%	9.0%	0.00	-1.11	-1.11	101.11	202.22	98.9
2.0%	8.0%	0.00	-2.22	-2.22	102.22	204.44	97.8
1.0%	13.0%	-1.02	3.37	2.35	97.65	195.31	102.4
1.0%	12.0%	-1.02	2.24	1.22	98.78	197.55	101.2
1.0%	11.0%	-1.02	1.12	0.10	99.90	199.80	100.1
1.0%	10.0%	-1.02	0.00	-1.02	101.02	202.04	99.0
1.0%	9.0%	-1.02	-1.12	-2.14	102.14	204.29	97.9
1.0%	8.0%	-1.02	-2.24	-3.27	103.27	206.53	96.8
0.5%	13.0%	-1.53	3.38	1.85	98.15	196.29	101.9
0.5%	12.0%	-1.53	2.26	0.73	99.27	198.55	100.8
0.5%	11.0%	-1.53	1.13	-0.40	100.40	200.80	99.6
0.5%	10.0%	-1.53	0.00	-1.53	101.53	203.06	98.5
0.5%	9.0%	-1.53	-1.13	-2.66	102.66	205.32	97.4
0.5%	8.0%	-1.53	-2.26	-3.79	103.79	207.57	96.3

1/ ((INT. IMP. % - FINAL IMP. %) / (1.00 - FINAL IMP. %) X 100
2/ ((INT. HUM. % - FINAL IMP. %) / (1.00 - FINAL HUM. %) X 100 (100 - IMP. REMOVED KG.)
3/ IMPURITY REMOVED KG. + HUMIDITY REMOVED KG.

TECHNICAL ANNEX VI.

A. Technical Revisions of Fair Average Quality Standards
B. Establishing a National Grain Inspection System
C. Costs of Grain Inspection System

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TECHNICAL REVISIONS OF FAIR AVERAGE QUALITY STANDARDS

PART: 1 BASIC CONSIDERATIONS & SCOPE

1.1 Fair Average Quality or FAQ is a term which refers to a set of grain quality characteristics and a corresponding pricing scale being employed in Pakistan to determine the price of wheat grain for government procurement. Public sector is presently involved in the procurement, storage and distribution of wheat to ensure the availability of this essential food item at regulated price in all parts of the country. To encourage production, an endowment price for wheat is announced by government for the benefit of farmers at sowing time each year. This is usually referred to as "procurement price" for government wheat. It should be obvious from the declaration of procurement price at sowing time that it implicitly applies only to the normal quality of Pakistani wheat. The FAQ specifications however, do not conform to the normal characteristics of Pakistani wheat nor any standardized equipment is employed by procurement agencies to determine its quality. This has resulted in a number of malpractices and management deficiencies in government organizations handling wheat. In the proposed procurement "pricing standards:, these fundamental discrepancies have been removed and the procedure for pricing wheat for government procurement streamlined.

1.2 Grain Storage Research Laboratory (GSRL) of Pakistan Agricultural Research Council (PARC), in collaboration with Food and Feed Grain Institute (FFGI) of Kansas State University (KSU), undertook in 1988, a survey under STDT component of US-AID aided Food Security Management (FSM) project to determine the quality of wheat harvested in 1988 in Pakistan. Random samples of wheat grain were taken from threshing floors and procurement centers from main production areas of the Punjab and Sind provinces for laboratory analyses. Fortunately, the harvesting, as well as the physiological maturity of the 1987-88 wheat crop took place under weather conditions which can be called the normal for Pakistan. The data resulting form this survey thus represented the normal characteristics of Pakistani wheat and was therefore, adopted to formulate these procurement pricing standards.

1.3 It is difficult to define a term like FAQ, for use in commercial deals involving commodities like "grain" which has "variation" as one of its normal natural attribute. It is even more difficult to apply the subjective attributes such as "fair" and "average" objectively in public dealings in a developing society like that of Pakistan. The name FAQ has therefore, been abandoned in favor of alphabets A, B, and C to specify the quality of a wheat lot in relation to the applicable standard price.

1.4 The three quality grades specified in the appendix to PART: 5 of these pricing standards, cover the full range of the physical quality characteristics variations actually recorded for Pakistani wheat in the

1988 survey. These standards may not thus be applicable to an abnormally wet wheat harvest or other abnormal weather conditions resulting in grain abnormalities in Pakistani wheat.

1.5 Some of the equipment prescribed in these standards for the quality grade determinations is mentioned by proprietary trade names. This has been done essentially to utilize the equipment already supplied to the concerned public sector organizations under the World Bank aided "Pakistan Grain Storage Project". These equipment can be replaced by other suitable equipment but only with the approval of a "competent body" dully constituted by government for this purpose. Furthermore, replacement if considered necessary, must take place from all the concerned agencies and at the same time. THis is essential to ensure uniformity in the application of these standards.

1.6 These pricing standards have been designed especially for use in the public sector for procurement of wheat in relation to the government wheat procurement price dully announced by Government of Pakistan as its endowment price. These may not therefore, be applicable in the general trade circles.

2.1 "Wheat" means:
Threshed grain containing not less than 90 percent, seeds of Triticum aestivum of normal size, shape and color; free from obnoxious smells and objectionable contaminants.

2.2 "Procurement Price" means:
The purchase price of "A" grade Pakistani wheat duly announced by the federal or a provincial government or a body constituted under law for this purpose in Pakistan.

2.3 "Wheat Grades" means:
A, B, and C qualities of Pakistani wheat determined as per quality grades specified in PART: 3 of the pricing standards.

2.4 "Damaged Wheat" means:
Wheat seed to which outer glume, stalk or any other part of the parent plant is attached or in which germination is visible and/or is discolored due to the effects of weather or a disease etc. and/or is holed, bitten or partially eaten by insect(s).

2.5 "Other Food Grain" means:
Edible seeds of plants other than wheat such as barley, oats, pulses etc.

2.6 "Broken and Shriveled" means:
Shrunken and broken kernels and other materials that will pass through a 0.064 by 3/8 inch size oblong hole sieve but retained on the top of a 5/64 inch size round hole sieve.

2.7 "Foreign Matter" means:
Organic and/or inorganic matter other than wheat which can be separated easily from wheat grain by using a set of two sieves. The top 12/64 inch size round hole sieve to retrieve dockage, stones and lumps of soil etc. and the bottom 5/64 inch size round hole sieve to retrieve sand, pebbles, grain dust, small weed seeds, insects and fragments. The sum total of the matter remaining on top of the top sieve and that which passed through the bottom sieve shall be taken together as foreign matter.

2.8 "Moisture Content" means:
Percentage of moisture present in the representative sample determined on wet basis by a Grain Analyst by using the apparatus and by adopting the procedures prescribed in these standards respectively.

2.9 "Consignment" refers:
To a grain quantity, comprising one or more lots, involved in a receival or dispatch activity.

2.10 "Lot" means:
A quantity of wheat not less one tone by weight which is offered by a person or a party for quality analysis and grading preceding procurement.

2.11 "Grain Analyst" means:
An authorized person possessing the requisite qualifications and skills to determine the quality grade of a wheat lot.

2.12 "Primary Sample" means:
Small quantity of grain taken from a single position (a bag, in case of grain in bags) in the lot.

2.13 "Composite Sample" means:
Total quantity of grain sample formed by combining and mixing together of the primary samples.

2.14 "Representative Sample" means:
Grain sample weighing roughly two to three kilograms; arrived at by reducing the size of the composite sample, if required, by a single or successive divisions, using a Riffle divider.

2.15 "Laboratory Sample" means:
One half portion of a representative sample arrived at by its division (into two or more parts, if required) using a Riffle divider.

PART: 3 WHEAT PRICING STANDARDS FOR PUBLIC SECTOR PROCUREMENT

Factors Applicable	Values Applicable		
Moisture Content %	Up to 9.0	> 9.0 to 10.0	> 10.0 to 12.0
Foreign Matter %	0 to 0.5	> 0.5 to 1.5	> 1.5 to 2.5
Broken & Shrivelled %	0 to 1.5	> 1.5 to 2.5	> 2.5 to 5.0
Other Food grains %	0 to 1.0	> 1.0 to 2.0	> 2.0 to 5.0
Damaged grains %	0 to 0.5	> 0.5 to 1.0	> 1.0 to 2.0
Quality Grade	A	B	C
Procurement Price	Full	Less two percent	Less five percent

ESTABLISHING A NATIONAL GRAIN INSPECTION SYSTEM

A. Defining FAQ

Provide definitions of FAQ factors that are within capability of producers to deliver. See following section.

1. Develop official instructions to measure quality factors.

2. Train staff to use equipment and procedure.
(The STDT is to assist PASSCO and the PFD's in developing quality control laboratories and training programs in August, 1988)

B. Provide a basic set of equipment inspection equipment at all procurement centers. More expensive and complex equipment would be phased into to central laboratories, zonal or district laboratories, and/or high volume / high risk procurement centers such as locations where combined wheat is delivered directly from the field.

C. Establish an official arbitration system for grain inspection, a judicial-like system of arbitration and appeals for inspection and grading. Such a system must be centered in locations with highly trained personnel and technical capability. The national seed laboratories one possibility. A cross-references system could be instituted so that the arbitration laboratory inspectors would not know the origin of the sample or persons involved.

D. Replace No-loss with an "minimum allowable shrink"

1. Modify accounting systems to record quality as well as quantity at each stage in the system.

2. Establish allowable shrink at different stages. For example, 0.1% each time grain moved and 0.3% per 4 months storage is a norm used in some countries.Some research and testing is needed for Pakistan conditions, but some nominal value could be used as a start.

E. Replace "recover value from employees wages" with system of bonuses for quantity maintenance below allowable shrink, at fixed quality.

F. Establish buying and selling systems on basis of a standardized specifications for volume of usable wheat purchased or sold.

1. Standardize FAQ allowable percentages for foreign material and moisture content. Adjust wheat as inspected to standardized base by use of lookup tables, mathematical formulas, computer programs, etc.

2. Work with buyers to develop buying specifications and pricing formulas to reflect quality differentials.

Note on Technical Annex VI-B

The Grain Storage Research Laboratory in Karachi prepared the Technical Recommendations for Pakistan Wheat Grading and Testing Procedures in October, 1988. The recommendations were reviewed by a panel of grain grading experts and technicians at Kansas State University at the request of the GSRL.

As a result of the review and further analysis of data collected in the 1988 Survey of Wheat Quality, the GSRL withdrew their original Technical Recommendations and developed new standards and specifications featuring an A, B, C grading system and pricing based ont eh B and C grades as a percentage of the A grade. Two parts of the revised standards and Grade A, B, and C specifications comprise Technical Annex VI-A.

As this report is being released, the GSRL is completing the parts specifying sample collection, test equipment, and summarized in future reprints of this report. The GSRL A, B, C Technical Recommendations will be issued as a separate report.

STDT/Islamabad
December 15, 1988

COSTS OF GRAIN INSPECTION SYSTEM

The following is an estimated cost of installing a grain inspection system nationwide. The costs do not necessarily require new budget allocations. Much of the expenses could be covered by a redirection of existing expenditures and savings from increased operational efficiency.

The installation strategy is provide each procurement center with a basic set of inspection equipment consisting of a riffle divider, triple balance beam scale, and sieve set. Some high volume centers may require more than one set for operating efficiency. Wheat reservoirs and godowns for long term storage should also have the same equipment to monitor wheat shipments as they arrive and as they are dispatched.

The cost per set is estimated to be:

Riffle divider (locally made)	500
3-beam scales with scoops	2,000
Sieves and bottom pan	1,000
	Rs. 3,500 set

The inspection equipment can pay for itself with just under 600 bags (60 MT) purchased if excess foreign material is detected and reduced from 3 percent to 1 percent.[26]

As FAQ standards are more strictly enforced, moisture meters will also be required. Moisture meters are expensive and need periodic calibration, maintenance, and care in usage. Laboratory type moisture meters cost about $2,000 per unit, can process samples in less than one minute, but are very sensitive to voltage fluctuations. Field type hand-held moisture meters cost from $250 to $600 each, operate from batteries and take 3 to 5 minutes per sample. Moisture meters vary considerably in their accuracy within given moisture ranges, therefore considerable care must be used in their selection and operation. Initial mass purchases of moisture meters should be avoided, and meters phased in on the basis of experience with the different types, the ability of the personnel, and FAQ specifications.

Moisture should not be a problem during most harvest seasons, particularly where the wheat is harvested by sickle and threshed in mechanical threshers. District or zonal personnel could spot check moisture content of grains in the field just before procurement centers open and check moisture content in the procurement centers where warranted. High risk in accepting wheat with excess moisture content (above 12 percent) exists where large volumes of wheat are harvested by combine and delivered directly from the field to the procurement center.

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[26] The savings, assuming bags cost rp. 17.5 and 100 kg of wheat costs 222 Rps., would pay for the equipment every time 591 bags of wheat were purchased. (17.5/0.02 + A(222)(0.02)= 3,500) A = 591 bags

The major cost of installing an inspection system will be in personnel training, changing of the management systems, and educating producers, private traders, processors, and the general public about the new system. Table xx presents a very conservative estimate of these costs. It is assumed that other public and private agencies such as the Agricultural Extension Service, public radio and television, the newsmedia, grain processors, and others will participate in efforts to disseminate information about the changes.

Cost of Equipping PFd's and PASSCO for Grading:

	No. Centers	Cost
Basic Grading Equipment @ rp. 3500 set		
PASSCO (all provinces)	271	948,500
Punjab	437	1,529,500
Sind	350 (est)	1,225,000
NWFP and Baluchistan	50 (est)	175,000
+ 15% extra sets for training, district laboratories, high volume locations, replacements	106	371,700
Moisture Meters		
20 automatic type for central laboratories, training, and high volume districts.		696,000
100 field type @ $400 ea.		696,000
Training[27]		
Training buying personnel and supervisors for grading @ rp.1,500	900	1,350,000
Training in accounting, inventory control @ rp. 3,000	200	600,000
Installation of grading system		
Prepare & print grading manuals, training materials, accounting forms, etc.		2,000,000
Publicity, farmer education, demonstrations, audio/visual materials		2,000,000
Subtotal		11,051,000
Contingencies/misc. expenses @ 15.0%		1,657,000
Total		Rp. 12,708,000
		($730,000)

[27] Does not include STDT/FSM costs of organizing and conducting training programs.

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