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PROCEEDINGS OF SEMINAR/WORKSHOP

GRAIN STORAGE MANAGEMENT RESEARCH AND TRAINING

Food and Feed Grains Institute
Manhattan, Kansas 66506-2202
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PROCEEDINGS

OF

SEMINAR/WORKSHOP

ON

GRAIN STORAGE MANAGEMENT RESEARCH AND TRAINING

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STORAGE TECHNOLOGY DEVELOPMENT AND TRANSFER/
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Kansas State University
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Manhattan, Kansas, USA

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WELCOME ADDRESS

M. Rafiq Khan[1]

Mr. Muhammad Sadiq Cheema, Secretary, Government of the Punjab, Agriculture Department; distinguished guests; faulty members; and ladies and gentlemen.

It is a matter of great pride and honor for me that for the inauguration of the Seminar/Workshop on Grain Storage Management, Research, and Training, Mr. Muhammad Sadiq Cheema, Secretary, Government of Punjab, Agriculture Department, is with us this morning. On behalf of the University faculty and myself, I whole-heartedly welcome him and thank him for sparing time out of his busy schedule and that shows his deep commitment to the very cause of agriculture and his personal attachment to this old and prestigious seat of learning.

Sir, let me acknowledge your presence today has been a source of great encouragement and immense pleasure for all for which we shall ever remain indebted to your goodself.

We all know that the honor and respect of nations depend to a great extent on the degree of their self-sufficiency in food. Those nations who have solved their food problems, not only retain their integrity but also lead a comfortable life during any crisis like famine or war. It is almost hard to deny the fact that governments which fail to solve food problems of their people, their very survival is put to stake. Somebody has rightly said, that it is possible to control the angry people but not the hungry masses.

Sir, it is quite evident that the gap of food requirement which has existed for years between the people of the developed and the developing countries is now getting even wider and this gap is not only limited to the food calories but also to the type of food. People in the developed countries normally enjoy meat protein while in the developing countries, it is becoming increasingly difficult for a common man to meet his daily food requirement.

Sir, according to a FAO report, almost 500 million people are now suffering from malnutrition and it is also a bitter fact that almost 200 million tons of food is wasted during its transfer from field to the eating table. In case this colossal wastage is controlled, it can certainly meet the food requirement of another 500 million people.

Sir, this is one side of the picture, the other side is even more dreadful. According to WHO, there are 100 million children up to the age of five years who suffer severely from hunger while another 900 million children are affected partially and 50% of these even succumb to death. It may be a little over estimated that shortage of food is the only cause of so many deaths, but it is a bare fact that shortage of food, does make them weaker and susceptible to various diseases which ultimately become the cause of death.

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[1] Vice Chancellor, University of Agriculture, Faisalabad, Pakistan.

Sir, when we see the overall scenario of food production, we have only two options to deal with, whether to increase production by bringing the uncultivated land under plough or by increasing the yield per unit by utilizing all the available resources. But for both of these production processes, a solid and viable national plan would be required. Until and unless the food produced is properly stored and protected, all efforts to benefit from these production strategies will go to waste. This practice is even true in countries like the United States, where it has been estimated that the grain storage losses go to the tune of US$ 400-500 million per year.

As far as Pakistan is concerned, it is an agricultural country. Seventy-five percent of its people live in the rural areas. Its land is rich and its soil is fertile. It has one of the most gigantic irrigation systems of the world, four seasons, lots of sunshine, and many more blessings to our agriculture. But at the same time, if people in general, and government in particular, do not tackle their problem in a bold and imaginative manner, then the nation is bound to suffer.

The problems which the farmers and agricultural scientists of our country are confronted with are too well known. Sir, what to talk of increasing the general agriculture production if we just ensure to protect the wastage of our current national produce from field to the storage and up to its use, it would be a substantial achievement. According to expert opinion, in Pakistan we lose about 10% to 15% of our total national stored grain from time of harvest of the crop to its use. Therefore in order to increase our national production, whatever efforts we do, is certainly not going to make any significant difference until we learn and skillfully practice the art of grain storage management through research and training.

To be perfect in this art, it would be most appropriate to understand Pakistan agriculture in a little detail. At the present moment, the total cultivated area in Pakistan is about four crores and eighty lac acres. This area belongs to 58 families, out of which 77% are those who have less than 12 1/2 acres. The area cultivated by such farmers comes to about 34% and a result of which whatever food grain is produced from this area gets very little chance to be sold in the market. The other 15% farmers are those who own more than 25 acres.

I would also like to mention that government only acquires 20% to 25% of the total produced while 5% to 7% is purchased by the urban population and thus almost 70% of the produce is left in the rural area. However, farmers do bring 90% more than their requirement to the market and it is this bulk of food grain which is purchased by the government and who is also responsible for its storage.

Sir, if we have a simple look on the production of wheat, rice, and maize in our country and also estimate the losses, the amount comes in millions a year. For example, if the wheat production is considered as 150 million tons a year and if 10% is lost, it means a shear loss of 12 1/2 lac tons of good grain, which if stored properly could meet the food requirement of 100 million people for a year. This is only one fact of the loss of grain - that is the loss in weight, while the other aspect is called the lack of quality which is even more important. Therefore, in the light of the earlier mentioned facts, it is so important to

understand the need of this Seminar/Workshop on Grain Storage Management, Research, and Training.

Unfortunately no university in Pakistan is offering any training on grain storage techniques using modern technology and likewise there is an acute shortage of trained manpower in this field. This is the underlying cause for the large-scale lack of education of our farmers in this area.

Sir, by learning the modern techniques in grain storage and proper management, we cannot only save the huge losses from the precious produce in our so demanding agriculture, but can also improve our productivity and food stability at the national level. Therefore, it has been decided to include grain storage management as an essential course at the basic level while the research and training in this field would also be taken up at the higher level. Through this program, Inshallah, we shall be able to save our grains from losses of millions of Rupees.

In the end, once again, I thank you Sir, for your kind and graceful presence in this workshop of national importance, for which I am certainly so obliged.

OVERVIEW OF POSTHARVEST SYSTEM IN PAKISTAN

Richard C. Maxon[2]

The purpose of this paper is to look at the present status of the wheat postharvest system, and to raise a number of issues and concerns about its future. There are two general approaches to the postharvest systems - the physical and the economic. We shall focus our attention specifically on wheat although other food and feed grain crops have similar problems.

If we had to summarize the situation in just one word, the word I would choose is "inadequate." Nearly all areas of postharvest management have problems, but some items and issues have reached the critical stage. The problems are more acute because the needs are growing and the resources available to cope with them are diminishing on all fronts.

Basics Supply and Demand

The Economic Wing (EC) of the Ministry of Food and Agriculture (MINFA), has been developing "Commodity Accounts" for various items. Their wheat accounts of 1984/85 - 1991/92 are most revealing. Let me state here that there are many unknowns in developing these accounts -- we will touch on them as needed. Suffice it to say that while the numbers may not be precise, the trends and proportions are quite indicative.

Table 1 is the overall balance sheet. I have taken some liberties in rearranging it from the original form. Two things are striking - a steady upward demand, a rapid increase in supply, and a fairly flat trend in production. The basic numbers are easier to assimilate in graphics form as found in Figure 1. Note the increases in carryover and imports since 1988/89.

Where does it go? What are, in wheat balance sheet terms, "Disappearances?" The most obvious of course is consumption as food in form of atta, maida, sujji, and etc. The basic data is shown in Table 1 and presented in graphics form in Figure 2. EW notes a decrease in per capita consumption in Table 2. This is masked by population increases. After food consumption, a portion of the crop is used as seed. Waste comes in two forms - the "avoidable" and "unavoidable" losses. Avoidable losses are due to inadequate storage protection, theft, leakages in transport, etc. These can be of any magnitude. Unavoidable losses are caused by friction of grain rubbing against each other in transport and storage - the dust that accompanies grain handling. Some shrinkage losses are inevitable in storage due to changes in moisture content over time. In a properly managed system, avoidable losses are 0.5% or 1% per year.

The biggest unknown is what is listed as "Other." In 1984/85 Pakistan exported a small amount of wheat. The substantial tonnage listed for the 1989 and 1990 crop years represent amounts presumably diverted into animal feeds, smuggled, or

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simply statistical errors. These need further investigation. Wheat is most plentiful and the cheapest poultry feed ingredient. A frequent estimate of wheat for poultry feed use is 400,000 Mt annually. There are natural constraints (fiber content) to the optimum use of wheat in poultry feed although many feed formulators tend to ignore them.

Take a closer look at the food demand and wheat production as illustrated in Figure 3. This should be a cause for concern. On the whole, production seems to be about keeping pace with demand trends. The problem is covering the wheat disappearances for seed, waste, and other uses.

Storage is Unavoidable

Figure 4 brings us to the postharvest issues. Figure 4 is an approximation of what happens. Virtually all Pakistan wheat production takes place between April and July, with the vast majority in May and June. Less than 1% of the total production takes place in months other than those represented here.

The consumption remains relatively stable year around, averaging about 1.2 million tons per month. All this wheat has to be stored somewhere, even if it is in the open in the farmer's field. According to the EW estimates, about 25% of the consumption is in "urban" areas. This leaves 75% for rural consumption. About 50% of the wheat crop is eventually marketed, the majority of it at harvest. The producers then store the major share of the crop. Some wheat is given to landlords who may store or sell; some wheat is given to harvest laborers as payment in kind.

Of the wheat that is marketed, about 70% eventually ends up in government godowns. Looking at it in another fashion, the Pakistan Agricultural Storage and Services Corporation (PASSCO) and the Food Departments acquire 30% of the total production.

On-Farm Storage

What does the farmer do with his crop? Store it, but under widely varying circumstances. One survey sponsored by EW provided the portrait in Figure 5. There is very little permanent, dedicated, on-farm grain storage. The farm family may typically have one ton or so of "pacca" storage for their food and/or seed supply. The rest is kept in "kacha" storage, most often bags stowed in the living quarters, sheds, or elsewhere. This impromptu storage seldom receives adequate protection from molds, insects, rodents, and etc. Families are often forced to sell their stocks to prevent further deterioration.

Private-Sector Storage

The private sector, primarily traders and flour millers, have less than 1 million Mt of storage. Most of this storage is in the mandis, or rural markets, according to a World Bank (WB) study. Flour mills typically will hold only a working stock, good for a week's production or less. Again, most of this storage is inadequate in providing protection for stored grains. The private sector does not find storage profitable. Government policies that fix support prices at the

same level year around do not provide for storage costs which rise as time passes. 'Pan-territorial' pricing which sets release prices nationwide is another factor limiting storage by the private sector. There's no advantage to looking for low cost wheat at harvest if the government will deliver wheat to you anytime, anywhere at the same price year around.

Public-Sector Storage

That brings us to the public sector, which currently has about 4.3 million Mt of covered wheat storage, plus seasonal amounts of temporary outdoor storage. The public sector also has some permanent storage for rice, oilseeds, and edibles, making the total a little over 5.0 million Mt. The public sector is playing an increasing role in wheat storage and releases. Figure 6 shows a rapid upward trend after abandonment of the ration shop system in April 1987.

The public's storage investment, with a replacement cost in excess of Rs 36 billion, consists of a hodge-podge of storage types, conditions, and outcomes. Figure 7 shows five types of covered storage totalling 4.3 million Mt. Note that three of the five types of covered storage are in bulk form. One other bulk storage form, bulk-cum-bag, is not shown as it uses conventional godowns. At the end of the 1992 harvest season, wheat inventories will probably be in excess of Rs 20 billion, counting carryovers. While some storage may be filled to overflowing, a good share of the public-sector storage will remain under utilized as shown in Figure 8.

This is because some of it, still carried on the books, is totally depreciated or obsolete and unsuited for storage. Other storage is in the wrong place due to changing production patterns, shifting population, and urbanization which prompts wheat production and/or makes the godowns inaccessible from a traffic standpoint. Other storage types, notably hexbins, are last to be used because of their high labor costs.

The nation has invested heavily in silos which have yet to reach their potential for technical and managerial reasons. In retrospect, bini-shells are not well suited for storage. They cannot be properly sealed for fumigation, and working conditions inside leave much to be desired. Another cause of the under-utilization is the shifting of procurement territories between the Food Department and PASSCO. They do not use the same locations each year.

Managing such a diverse collection of storage is difficult. Each storage type has its own requirements for equipment, manpower, insect control techniques, and etc. The problems are compounded by the complicated and unwieldy procurement and distribution system. About 3,000 temporary buying locations are established each year - ostensively to provide producers with easy access to markets. However, the vast majority of wheat entering the public-sector godowns actually comes through middlemen. Wheat entering public-sector godowns is presumably FAQ quality, but in practice, no objective measurements are taken.

From the procurement center, wheat may take several divergent paths. Figures 9 and 10 indicates some of the problems dealing with the divergence of storage types. The operative word may be "interfacing" - shifting from one location to the next. It is theoretically possible for wheat to be in and out of the bag

four times on this journey. Probably one-fourth to one-third of all wheat ultimately delivered to the flour mills has been in and out of a bag twice. All this is a costly exercise. You will hear more later about efforts to introduce bulk handling to reduce costs and efforts. The average cost per Mt for wheat distribution through the public sector is probably in excess of Rs 1,000. Carrying 1 Mt of wheat over from one year to the next costs more than Rs 250 in storage costs, interest, shrinkage, etc. There seems to be an innate faith that masses of cheap labor can overcome whatever structural flaws or design errors exist in present-day storage systems. However, this situation is changing as the pool of manpower willing to carry bags is diminishing as the needs are increasing.

How much carryover? This brings us back to an interesting point from the wheat balance sheet, the estimated carryover or ending stocks on May 1 each year. Government statistics can be obtained, after a suitable delay of course. The private sector is nearly a complete blank as far as reliable stocks on hand information is concerned. But remember, all that wheat has to be somewhere or accounted for. Figure 9 shows recorded public-sector carryovers - plus the estimated private-sector stock carryovers as calculated from disappearance. The private-sector carryover may or may not exist, or it may have existed and been smuggled, fed to poultry and livestock, or simply lost through waste.

Public Investments and Subsidies

The need to know more about private-storage holdings is more than an academic exercise. Given the level of storage and distribution costs, plus the government's desire to hold down atta prices is costly. Since 1987 some attempts have been made to recover storage and distribution costs, but atta price increases have not been sufficient to offset the subsidies going into wheat. The gap between the current procurement and release price is Rs 300, plus Rs 15 for the bag which costs about Rs 27 new. Figure 10 shows the trends and amounts. Over Rs 20 billion in subsidies have been paid in the last five years. Much of the subsidies are required because imported wheat is distributed at the same price as domestic wheat, even though it is more costly.

There is much reason to question if such subsidies can be continued in light of benefits being received in form of cheap atta. The ration shop system was abandoned when subsidies costing Rs 1.8 billion returned benefits of only Rs 250 million according to one study. The benefits would have been even lower if the quality of atta had been taken into account. Now subsidies have touched Rs 7 billion, and is still climbing. Who gains and loses needs careful examination in light of pressing other needs in health, education, infrastructure, the environment, and a host of other problems (Figure 11).

Wheat imports have risen in part because of the many unknowns apart from consumption of wheat for food. Going back to Figures 1 and 3, it was seen that wheat production is close to wheat consumption for food. Add a little more for seed, and some unavoidable losses. These can be reasonably estimated. But what about the amounts for avoidable losses, feed for poultry and livestock, and the unaccounted balances for industrial uses, smuggling, or just plain statistical errors. Are such large carryovers, subsidies, and imports justified on the basis

of so many unknowns in our postharvest system? I hope these items will be discussed and debated in the course of this seminar workshop.

Postharvest Issues in Wheat

1. If per capita consumption of wheat is going down, is wheat becoming an "inferior good" for consumers?

   If the above is true, can the current levels of subsidies and market interventions remain justified?

   Could quality control, better storage, and processing methods reverse the consumption trend?

2. Who should store wheat?

   Producers/producer associations
   Public agencies
   Federal
   Provincial
   Private sector
   Some combination of the above

3. How should storage be done?

   What can be done about the large number of storage types now in use?
   Should some storage types be abandoned?
   What is role of bulk handling?

   Should pricing incentives be given for storage in form of:
   Seasonal pricing?
   Territorial pricing?
   Quality premiums and discounts?

4. How can Pakistan postharvest systems be modernized?

   Improved storage practices and reduction of storage losses.
   Introduction of grades, standards, and quality control.
   Upgrading milling industry and downstreaming product development.

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TABLE 1

WHEAT BALANCE SHEET
(1,000 Mt)

Supply

Market Year	Production	Imports	Opening Stocks	Available Supply
1984/85	10,882	925	4,029	15,836
1985/86	11,703	1,843	2,951	16,497
1986/87	13,923	482	3,267	17,672
1987/88	12,016	483	3,991	16,490
1988/89	12,675	2,109	2,621	17,405
1989/90	14,419	2,240	3,180	19,839
1990/91	14,262	1,738	4,562	20,562
1991/92			4,696	

Demand

	Food	Seed	Waste (2.6%)	Other* Uses*
1984/85	12,209	306	317	53
1985/86	12,581	322	327	
1986/87	13,001	344	338	
1987/88	13,214	310	344	
1988/89	13,532	342	352	
1989/90	13,824	347	359	746
1990/91	14,237	350	370	909
1991/92	14,644			

*Other includes exports (1984) and unexplained disappearances

Balances

	Implied Disappearance	Ending Stocks	Govern-ment Stocks	Private-Sector Stocks
1984/85	12,885	2,951	745	2,206
1985/86	13,230	3,267	1,227	2,040
1986/87	13,683	3,991	252	3,739
1987/88	13,868	2,621	1,200	1,421
1988/89	14,226	3,180	1,826	1,354
1989/90	15,276	4,562	1,412	3,150
1990/91	15,866	4,696	900	3,796
1991/92				

Source: EPA/EW, MINFA

TABLE 2

WHEAT AND WHEAT FLOUR CONSUMPTION

Year Category	Unit	1984-85	1985-86	1986-87	1987-88	1988-89	1989-90	1990-91	1991-92
Population	Million								
Rural		66.69	68.80	72.20	73.10	75.33	77.44	80.26	83.07
Urban		28.04	28.93	28.50	30.72	31.67	32.56	33.74	34.93
Total		94.73	97.73	100.70	103.82	107.00	110.00	114.00	118.00
Per Capita Consumption	Kg								
Rural		139	139	139	137	136	135	134	133
Urban		105	104	105	104	104	104	103	103
Total		129	129	129	127	126	126	125	124
Total Consumption	1,000 Mt								
Rural		9,275	9,561	10,016	10,016	10,246	10,454	10,753	11,046
Urban		2,934	3,020	2,986	3,196	3,287	3,371	3,484	3,598
Total		12,209	12,581	13,001	13,214	13,532	13,824	14,237	14,644

Source: Population date from Economic Survey, 1990/91, p 17.
Per capita consumption -- HIES

TABLE 3

COMPARATIVE COST OF WHEAT SUBSIDIES AND
EXPENDITURE FOR EDUCATION AND HEALTH, 1974-1989
(Billions Rupees)

Year	Wheat Subidies	Education Total Expenditure	Health Total Expenditure	As a Percent of GNP Wheat	Education	Health
73	1,917	1,153	386	2.2	13.2	0.43
74	2,119	1,775	641	1.9	10.8	0.57
75	1,183	2,275	690	0.9	5.9	0.74
76	1,092	2,299	979	0.7	5.4	0.63
77	1,615	2,963	1,071	0.9	6.3	0.57
78	2,513	3,112	1,211	1.6	8.2	0.58
79	1,757	3,502	1,379	0.7	4.9	0.55
80	1,052	4,191	1,737	0.4	2.6	0.58
81	1,303	5,001	2,030	0.4	2.8	0.58
82	1,122	6,154	2,390	0.3	1.9	0.59
83	1,257	7,522	3,091	0.3	1.7	0.67
84	2,041	9,350	3,373	0.6	3.1	0.66
85	3,832	10,711	4,275	0.7	2.8	0.77
86	2,785	14,887	5,885	0.3	1.8	0.97
87	3,917	17,132	7,178	0.6	2.1	1.02
88	8,273	19,482	7,321	1.0	4.0	0.92

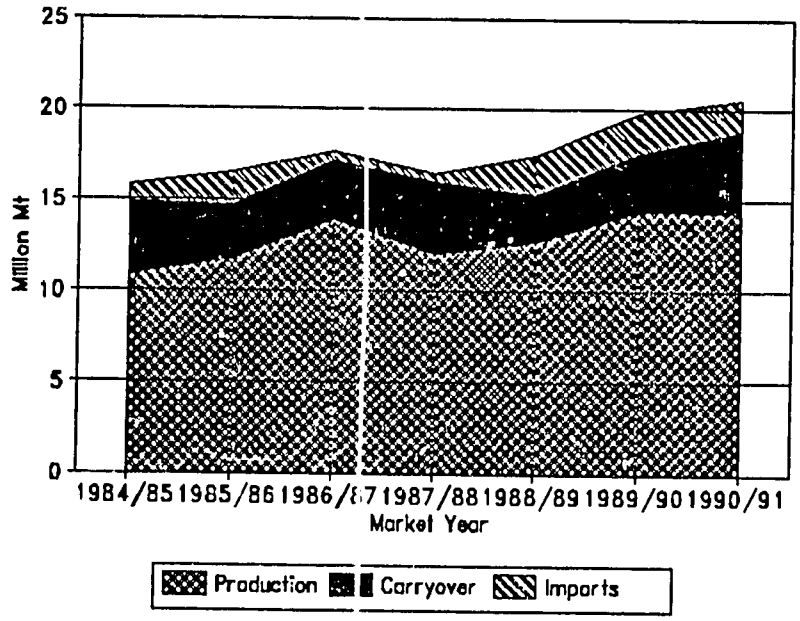


Figure 1. Wheat Availability, Market Years 1984-1990.

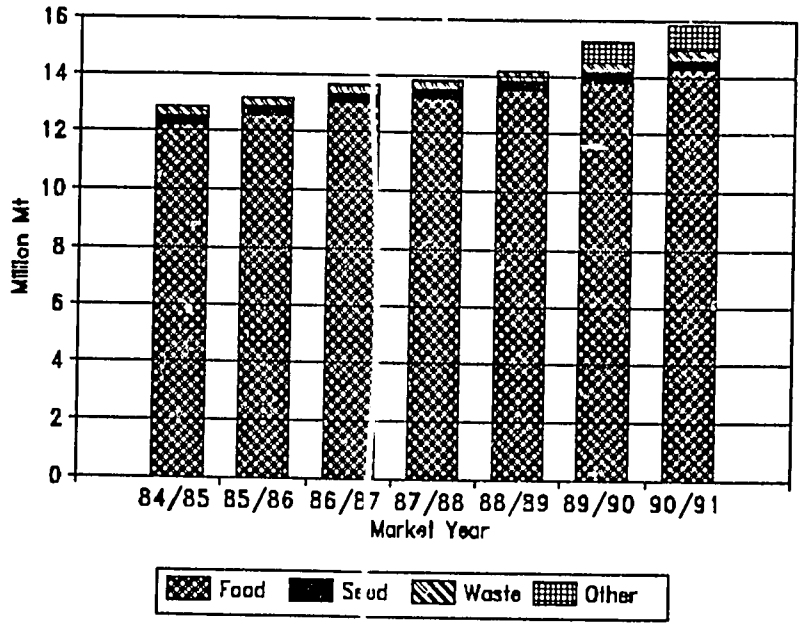


Figure 2. Wheat Utilization, Market Years 1984-1990.

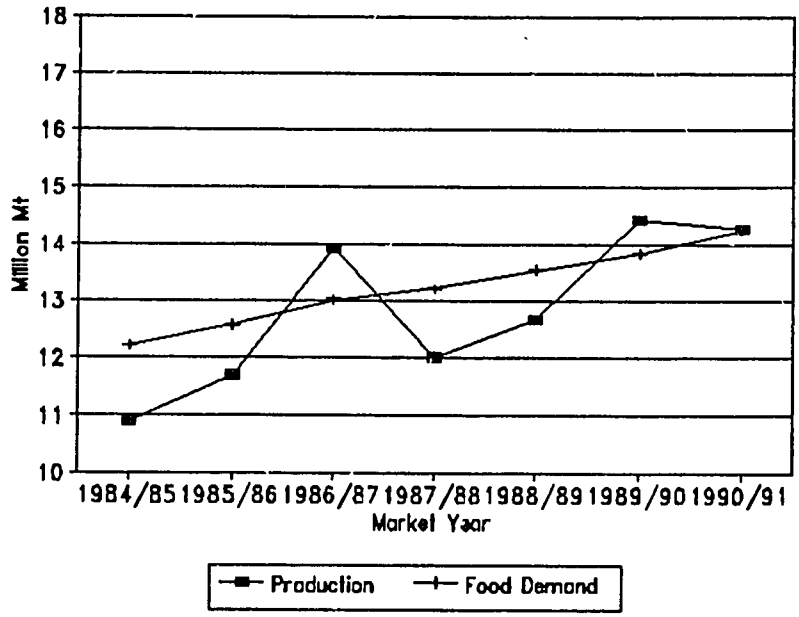


Figure 3. Wheat Production and Food Demand, Market Years 1984-1990.

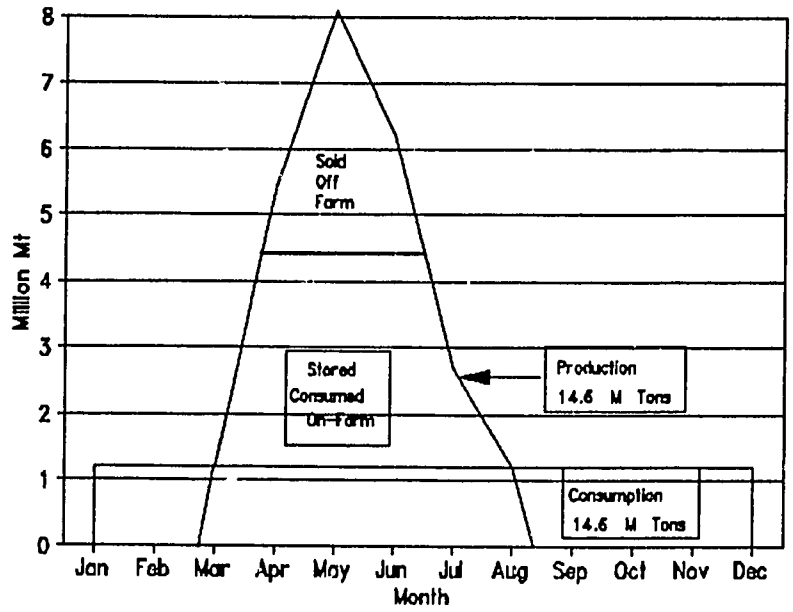


Figure 4. Wheat Production and Consumption, Quantity Produced, and Consumed per Month.

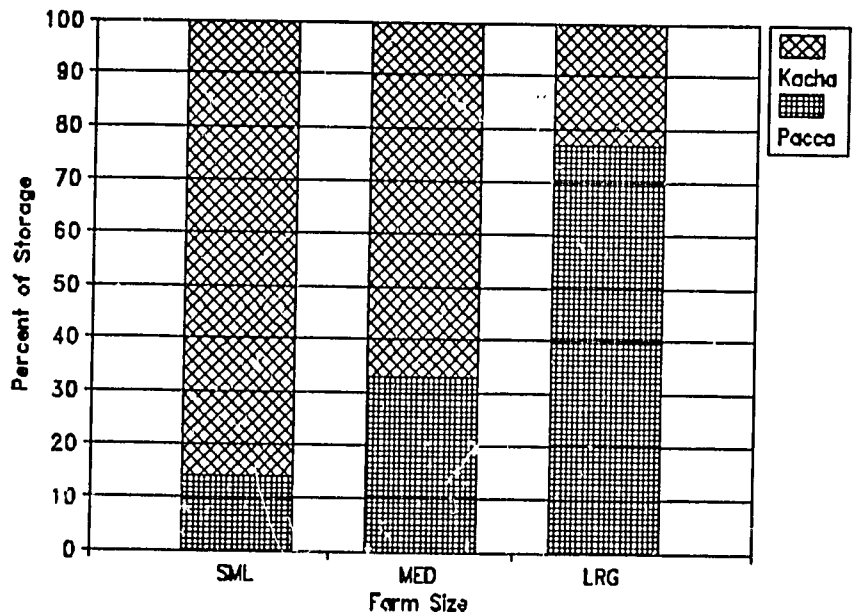
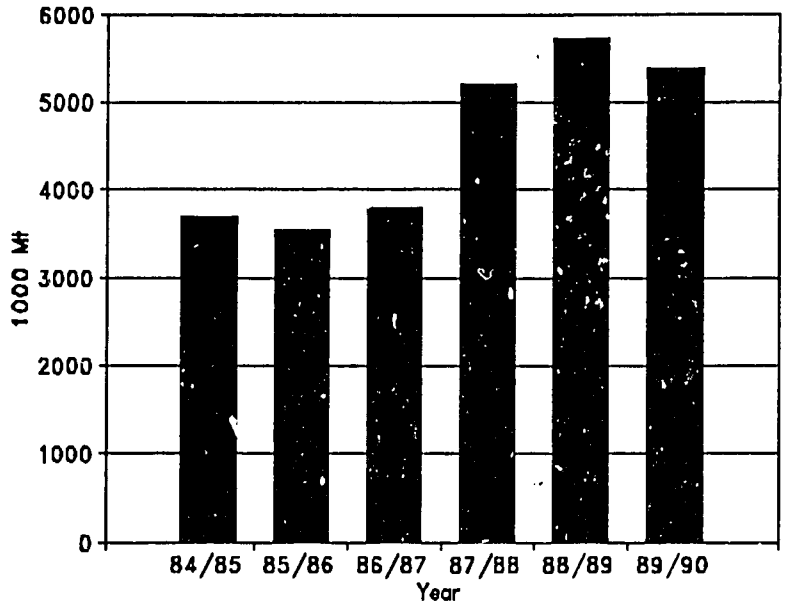


Figure 5. Pacca and Kacha On-Farm Storage, Percentage by Size of Farm.



Pakistan: Annual Releases of Wheat

1,000 Mt

1984/85	3,695
1985/86	3,543
1986/87	3,793
1987/88	5,202
1988/89	5,717
1989/90	5,386

Source: Economic Survey, 1989-90

Figure 6. Public-Sector Wheat Releases, Fiscal Year 1984-1990.

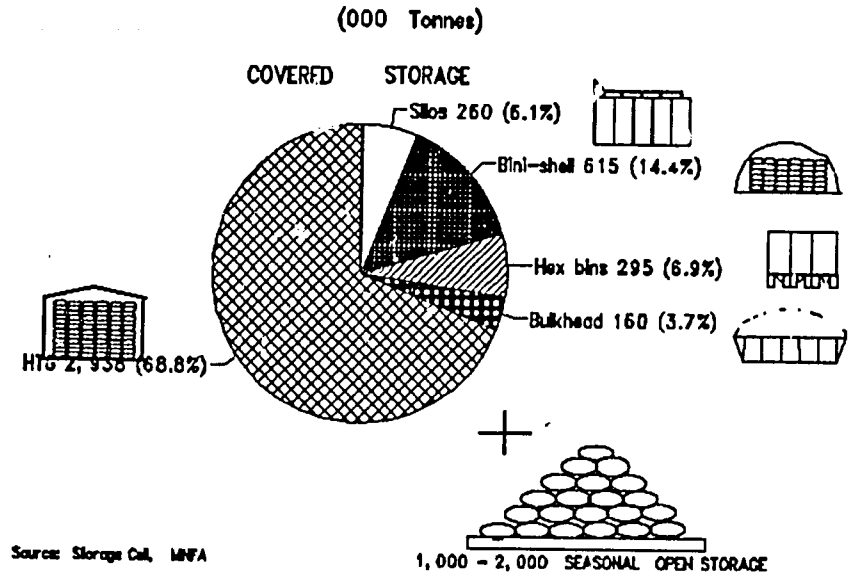


Figure 7. Types of Public-Sector Wheat Storage.

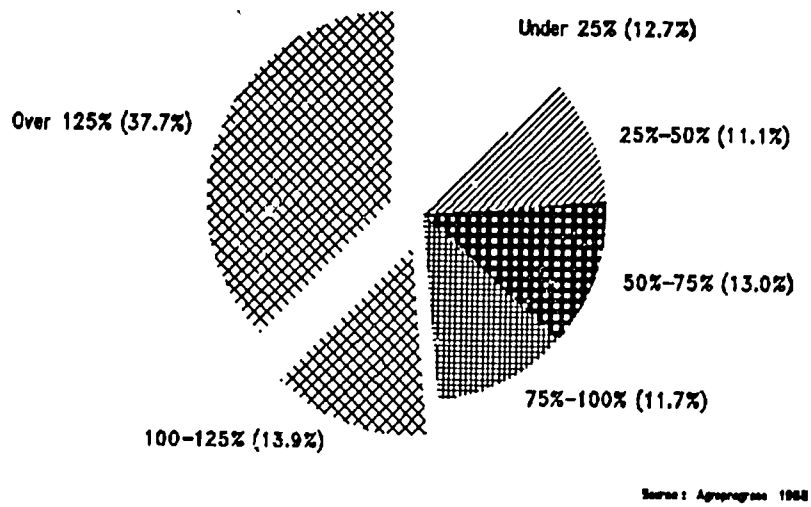


Figure 8. Maximum Capacity Utilization, Percent of 324 Storage Centers.

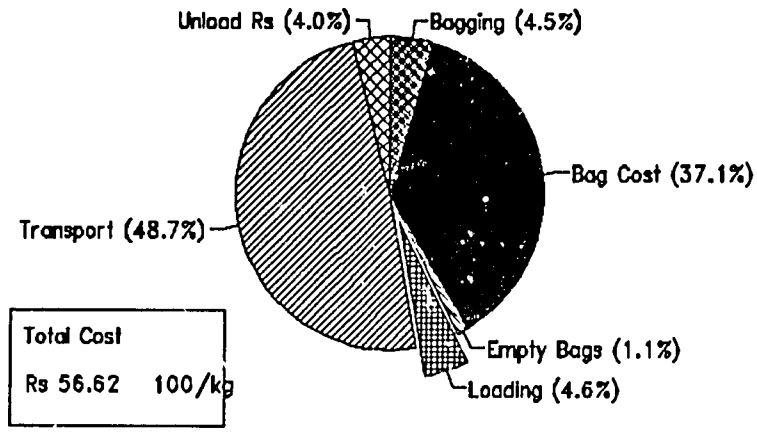


Figure 9. Estimated Handling Costs From Field to Flour Mill (Per 100 Kilograms).

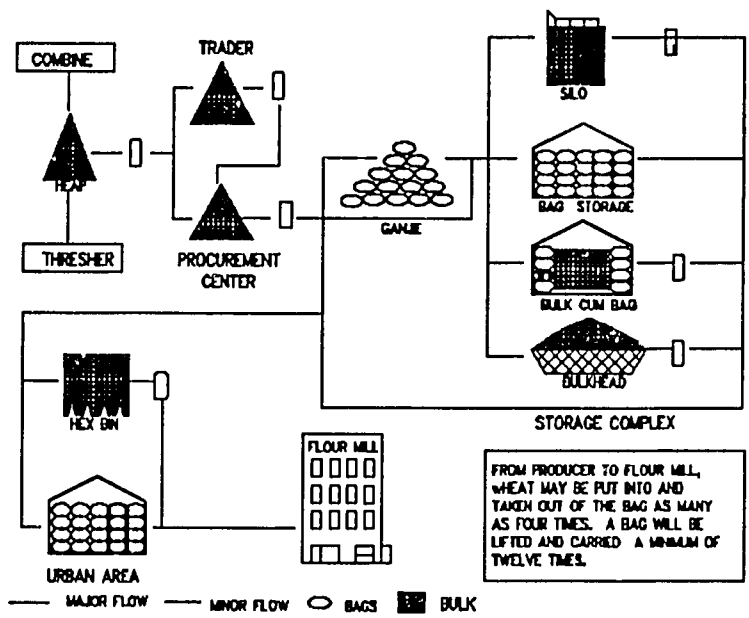
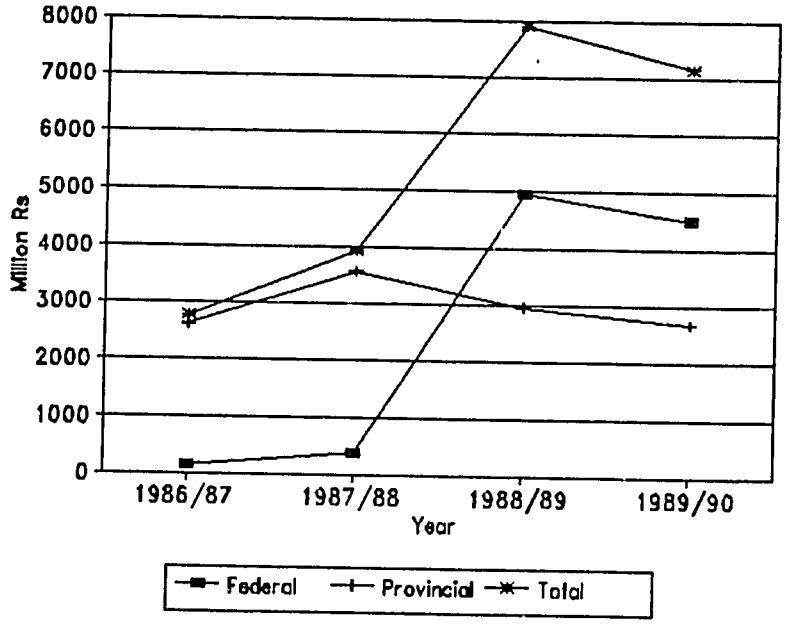


Figure 10. Wheat Flow from Producer to Flour Mills.



PAKISTAN: WHEAT SUBSIDIES
(Rs Millions)

Fiscal Year	Federal	Provincial	Total
1986/87	150	1,625	2,775
1987/88	368	3,549	3,917
1988/89	4,947	2,956	7,903
1989/90	4,492	2,667	7,159

Source: Government of Pakistan

Figure 11. Pakistan Wheat Subsidies, Fiscal Years 1986-1990.

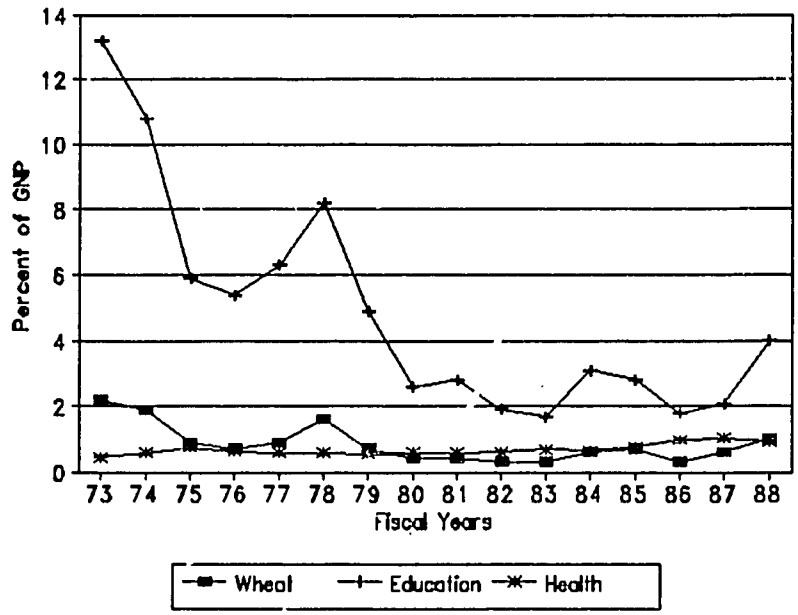


Figure 12. Comparative Cost of Wheat Subsidies and Expenditure for Education and Health.

FEDERAL GOVERNMENT FOOD POLICIES

Muhammad Bashir[3]

Wheat is the staple diet of people in Pakistan and it accounts for about 70% of the total food grains. The other main food grain is rice which accounts for 20%. Rice is not only a supplementary diet of Pakistani people but also a major source of foreign exchange earnings for the country. The consumption pattern and dietary behavior of the population for wheat and rice is not expected to change significantly in the future.

Food Policies

There are three major components of the food policy of the Government of Pakistan:

1) adequate production of food,
2) stability of food prices, and
3) access to food by the consumers.

An adequate food supply is the cornerstone of food security. Ultimately, food security is a matter of ensured access, both physical and economic, by all to adequate amounts of food. Unless, an adequate national supply is coupled with appropriate food and agriculture marketing facilities, equitable rural development policies, price stabilization mechanism, and most importantly, adequate access to the means of production or other income generating opportunities for the poor, household food security for all cannot be achieved. The need is to expand and strengthen the food production and supply base by increasing the productivity of the land through labor-incentive technologies.

Every possible efforts is made by the government to maximize production. Subsidized inputs and bank loans at concessionaire rate are provided to farmers. Support prices as incentive to produce more grain are announced well before the commencement of the time for sowing. Information on improved farming techniques is disseminated through mass media and extension services. Agriculture is given adequate support within an already strained development budget. All these efforts are meant to stimulate sustainable production.

Pricing Policy

The most important instrument for raising agriculture production is to ensure reasonably return to the farmer for his labor and capital inputs. Unless he is assured of a minimum price he would be reluctant to invest in crop production. To determine support/procurement price, the government has established an Agricultural Prices Commission. The support/procurement price is announced by the government before the sowing season to enable the farmer to plan the area and arrange inputs.

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3 Joint Secretary (Food), Ministry of Food and Agriculture, Islamabad, Pakistan.

The support/procurement price of wheat over the last decade has been increased by 93% in absolute terms. In 1981-82 the support price was Rs 1450 per Mt while it was raised to Rs 2,800 per Mt for the 1991 harvest. The Agricultural Prices Commission while determining support price of wheat takes the following factors into account:

1) Cost of production.
2) Domestic demand, supply and stocks.
3) World demand, supply, stocks and trade,
4) International prices,
5) Import parity prices,
6) Changes in real prices of wheat,
7) Support prices in some other countries,
8) Profitability of fertilizer use on wheat,
9) Comparative economic position of wheat vs competing crops/combinations, and
10) Impact of increase in support price of wheat on:

    a) Consumer price index, and
    b) Household budget.

The Commission besides recommending the minimum support price every year also recommends some non-prices measures for improving productivity and marketing. These measures relate to the use of seed and fertilizers, cultural practices, etc. and are implemented by the provincial governments and other concerned agencies.

The Provincial Food Departments and Pakistan Agricultural Storage and Services Corporation (PASSCO), an agency under the federal government, are the main agencies which purchase wheat from growers at the fixed support price. These organizations establish procurement face any difficulty in disposal of their produce. Around 25% of the total wheat produced is procured by the public sector. The procurement operation is voluntary and in case the growers can sell their produce at higher price they are free to do so. It is the policy of the federal government to induce private trade in wheat. The objective is being achieved by widening the difference between the support and issue prices.

The stability of food prices in the country is maintained by ensuring payment of government notified prices to the growers for their produce on the one hand and sufficient stocks are released in the market at a fixed price to work as a deterrent against price hike. The consumer is thus protected against unaccountable profit of the traders during poor harvest period and the farmer is also not exploited during years of good harvest. The issue price not only realizes the procurement price but also recovers some portion of the incidental charges is to the extent of about 64% while the remaining 36% are borne by the government as subsidy.

The result of the policies pursued by the government is evident from the developments in wheat production. Its area during 1980-81 and 1990-91 has increased by 13.3%. In 1980-81 the production stood at 11.47 million Mt. In the year 1990-91 it was 14.56 million Mt.

Pakistan has been self-sufficient in wheat in certain years and deficit in the others. As self-sufficiency represents an equilibrium between the production and requirements in which production has to increase continuously to match the ever increasing demand for consumption, population growth at a rather fast rate calls for tremendous persistent efforts to meet the expanding wheat requirements. Whenever indigenous production falls short of the requirement, the deficit is met through imports. Till recently, imports were mainly made from U.S.A. with a few imported some quantities from Australia and Canada. Efforts are underway to import some quantity from Saudi Arabia and Turkey. There are other sources like EEC countries which are planned to be tapped. The private sector has also been allowed to import wheat.

The food management and stock policies of the government are directed towards smooth flow and continuous availability of food grains to the urban areas and needy rural population of the country. The main objective of the food policy is thus to arrange for the public distribution of food grains through government machinery (in addition to making grains available through private sector), at a certain price fixed by the government.

To implement the objective of food policy the Ministry of Food and Agriculture is responsible for the formulation of food-grains policies and their enforcement. These policies include the fixation of targets, i.e., local procurement, import of wheat if so required, and public-sector distribution. At the provincial level the Food Departments of the respective Provinces carry out the administrative as well as operational activities connected with procurement, movement, storage, and distribution of food-grains in keeping with the guidelines given by the federal government. Apart from Food Departments, PASSCO is also operating in the country under the federal government. PASSCO has its purchase centers spread in the surplus districts. PASSCO is also responsible for construction of modern storage in various provinces of the country.

Stock Policy

The stocking policy followed by the Government of Pakistan is based on the following broad considerations:

1) The level of stocks maintained should serve as the essential bulwark against food insecurity in any part of the country.

2) The stocks should be available for free and uninterrupted flow into the public distribution channel without any serious disruption even if there are failures and consequent fluctuations in food grains production.

   In keeping with the aforesaid considerations, an endeavor is made to maintain a reserve of approximately 1 million Mt.

INTRODUCTION TO GRAIN STORAGE MANAGEMENT DIPLOMA COURSE

Manzoor Ahmad[4]

Mr. Chairman and Dear Colleagues:

You are very well-aware that grain storage management is as important a field as grain production itself. Proper storage management and distribution has a direct relationship with the independence of nations and stability of national governments. No hungry nation can survive independently. Higher post-production losses are also an indication of the backwardness of a nation; the higher the losses greater is the backwardness a nation. Postharvest losses are much higher in the developing countries as compared to the developed ones. In Southeast Asia, postharvest losses have been recorded. Even in the U.S.A., a developed country of the world, post-production losses up to 5% have been recorded. Chaudhri (1980) reported aggregate postharvest losses of 17.1% in paddy, 15.3% in wheat, and 12.6% in maize in Pakistan. Sabri et al. (1984) and Khan et al. (1985) reported 7.836% postharvest losses of wheat in one tehsil of the Faisalabad District. Khan et al. (1986) recorded 6.53% postharvest losses in paddy in Daska Tehsil of the Sialkot District.

As the world population grows, increasing food supply becomes an ever-more-priority. By the year 2,000, it is projected that the world population would increase to between 6 to 7 billion and it has been estimated that more than one billion people would not have enough to eat. In Pakistan, the population is growing at a rate more than 3% annually and is likely to attain the level of 150 million people by the year 2,000 A.D. An addition of 35 lac new mouths every year indicates the important of making every possible effort to meet food requirements not only of today but also of tomorrow. By the target year, we may need approximately 20 million Mt of wheat and 5.4 million Mt of rice.

It is a matter of common knowledge that 10% losses during storage are not uncommon. If these losses are not contained, there is every likelihood that efforts made towards self-reliance and self-sufficiency would not yield tangible results. It is really unfortunate that the grain storage did not receive due attention of the scientists and policymakers. In spite of the fact that grain storage is a high technical subject, no formal training or professional education of any level has ever been considered a pre-requisite for the magnitude of grain storage losses and the improved management practices. The worst part of it is lack of realization with regard to the effect of these losses on public health and prosperity. On the basis of past experience of in-service training in the grain storage management, it has been observed that efforts put in this direction did not yield tangible results because the persons under training were not able to assimilate the technical information due to lack of scientific background.

I feel great pleasure and satisfaction to inform this house that this university has taken a lead in developing one-year diploma course in grain storage manage-

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[4] Professor, Department of Agriculture Entomology and Coordinator, Grain Storage and Research, University of Agriculture Faisalabad.

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ment. It took us about a year in achieving consensus on national levels on the appropriateness and the usefulness of this programme. I am sure, this diploma, in due course of time, will become a pre-requisite for entry into service in food handling agencies. The following 11 courses will be taught during two semesters, besides extensive practical training in the field. It is multi-disciplinary in nature that involves six different fields of specialization, viz., Agriculture Entomology, Plant Pathology, Crop Physiology, Agriculture Marketing, Food Technology and Basic Engineering. I can say with confidence that the university is the only place where this type of coordinated program of teaching and research can run smoothly and efficiently.

List of courses approved for the diploma in Grain Storage Management:

Course	Title	Credit Hours
GSM-1	Introduction to Grain Storage Management	5(2-6)
GSM-2	Grain Structure	2(1-2)
GSM-3	Insect and Mite Pests of Stored Grain	5(3-4)
GSM-4	Vertebrate Pests of Stored Grain and Their Management	3(2-3)
GSM-5	Stored Grain Microflora and Their Management	4(3-2)
GSM-6	Food Polices and Laws	2(1-2)
GSM-7	Grain and Storage, Inspection and Bookkeeping	3(1-4)
GSM-8	Food Grains Marketing and Procurement	3(2-2)
GSM-9	Storage Systems	4(1-6)
GSM-10	Grain Protectants and Fumigations	4(2-4)
GSM-11	Introduction to Grain Processing and Flour Milling	4(2-4)

In the end, I would my express gratitude to those who positively contributed in giving the diploma course its present shape. I am particularly grateful to the university faculty, the scientists working in PARC, Punjab Seed Corporation, Punjab Food Department, Federal Ministry of Agriculture, PASSCO, and STDT/USAID for their cooperation and contribution in developing this program, the first of its kind in Pakistan. I also gratefully acknowledge the support and guidance, I received from the worthy Vice Chancellor Prof. Dr. M. Rafiq Khan, without his kind help it would have been a dream to think of developing and initiatinal Diploma Course in the Grain Storage Management.

I feel myself duty bound to bring it on record that the credit of this useful venture goes to Mr. Sajjad Hussain, the then Secretary, Food Department, Government of the Punjab, who to the university through the Secretary Agriculture for developing a Diploma Course.

INAUGURAL ADDRESS

Chaudhry Muhammad Iqbal[5]

Mr. Vice Chancellor; Secretary Agriculture, Punjab; Secretary Food; respected professors; distinguished scientists; ladies and gentlemen.

It is a matter of great privilege and pleasure for me to be among such a galaxy of scientists and learned people today. I am really happy to know that the Univerity of Agriculture decided to start a diploma course in grain storage management. There were no arrangements for producing adequately trained manpower for employment in grain handling agencies. There is no denying the fact that grain storage is a highly technical subject but, unfortunately, the importance of producing trained manpower has been ignored in the past. The present arrangements will definitely be helpful and instrumental in avoiding heavy quantitative and qualitative losses of food grains at the farm level as well as during storage and processing.

The bulk of harvested cereal grains passes through a well defined series of steps in the postharvest system including threshing, drying, storage, and processing. The losses of produce certainly go very high due to one reason or another. It is therefore, imperative to adopt modern scientific methods for drying and storing cereal grains to minimize losses. Pakistan is the ninth most populous country with the fastest growth rate in the world. The burgeoning population, i.e., 3.5% per anum, is continuously increasing the burden on natural resources and there is no scope of expanding the area under food crops and avoid post-production losses, in order to be able to meet the food demands of the rapidly increasing population.

I hope that the scientific and technological principles of grain storage will be cussed in detail by the experts and participants of the workshop; and they will also adequately utilize the knowledge gained during the training to save the grains from storage losses. I am sure the University of Agriculture will continue to play its role in leading the nation in pursuing the policy of self-reliance and self-sufficiency.

It may not be out of place to mention that the grain storage management is as important as grain production, demanding the serious attention of scientists. Continuous and concerted research efforts are needed to develop and transfer grain storage technology to the end users. I am sure that the post-production of food grain will receive priority in research and extension programs in the field of agriculture and I can forsee that the day is not far away when grain science will emerge as an independent discipline and the university will produce graduates and post-graduates in this important field.

With these few words, I inaugurate the Seminar/Workshop on Grain Storage Management, Research, and Training and wish you all success.

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[5] Minister for Agriculture, Punjab.

INAUGURAL ADDRESS

Muhammad Saqiq Cheema[6]

Mr. Vice Chancellor, respected professors, distinguished scientist, ladies and gentlemen:

It is a matter of great privilege and pleasure for me to be among such a galaxy of scientists and learned people today. I am really happy to know that University of Agriculture has decided to start a diploma course in grain storage management. There were no arrangements for producing adequately trained manpower for employment in grain handling agencies. There is no denying the fact that grain storage is a highly technical subject but, unfortunately, the importance of producing trained manpower remained ignored in the past. The present arrangements will definitely be helpful and instrumental in avoiding heavy quantitative and qualitative losses of food grains at the farm as well as during storage and processing.

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With these few words, I inaugurate the Seminar/Workshop on Grain Storage Research and Training and wish you all success.

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[6] Chief Guest, Secretary of Agriculture, Punjab.

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WHEAT QUALITY REQUREMENT FOR FOOD INDUSTRY AND PROBLEMS FACED

Beda Rust[7]

Introduction

Let me thank first the workshop organizer who offered me this opportunity to speak to you as a representative of industrial customers for high quality wheat flour.

I would like to split my presentation into three parts: (1) our requirement for high quality what flour; (2) specification for the type of wheat flour we look for; and (3) in-line controls for mills and wheat flour manufacture and its justification.

Our Requirement of High Quality Wheat Flour

Nestle-Milkpak Ltd. Pakistan is a company with a wide network for manufacturing food products. A large segment is devoted to milk and cereal based infant food products. We deal therefore with the most sensitive customers existing and the most critical purchasing group, the young mothers purchasing food items for their infants and small children.

We decided to manufacture our cereal infant formulas consisting today of six varieties of babies cereals in Pakistan. Four products are from wheat bases and two products are from rice bases. Our priority is to tune to the income group which traditionally purchased the imported products, offering a locally manufactured product equal to imported ones, in respect of organoleptical and bacteriological quality. We are following the local legislation plus the WHO codex alimentarus simultaneously, or what is more strict of the two. We of course will expand our sales with the cost opportunity into lower income groups plus have the option exporting our branded product to traditional Nestle import markets, such as Iran and Bangladesh, with Pakistan manufactured products of international standard.

Wheat Flour Specification for Our Products

As a principal, we are applying in Pakistan the same strict quality criteria as in all other markets and have made an all out effort to find millers willing to adhere to our standard of quality.

A very vital aspect to have very strict criterial is the danger of infestation of our factory environment and processing lines with insects from unhygienic wheat flour, dirty flour bags, leaking bags attracting insects, contaminated flour, etc., which can be for us a question of closing the factory and/or large losses of business and our reputation.

Production Chief, Nestle Milkpak, Lahore, Pakistan.

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Let us see the main aspect of the specification which permits correct decision for flour release and indicators of possible problem arears in the flour mill:

Item		Identified Quality Problem
Moisture	1.	Keeping the quality of flour during storage, especially mold growth and oxidation.
	2.	Manufacturing losses if too low.
	3.	Indication of insufficient/extensive water consumption of grain cleaning.
Dirt	1.	Cleanliness of wheat grains and milling processs.
	2.	Bags quality and bagging section.
	3.	Milling quality and operation of separators.
	4.	Infestation of insects in the mill.
Ash	1.	Milling quality.
Lipase	1.	Level of active enzymes in flour leading to oxidation.
	2.	Age of flour and expected shelf life.
	3.	Harvest and postharvest problems of grains.
Microbiological Quality	1.	Cleanliness of wheat used.
	2.	Grain storage problems.
	3.	Water quality used in grain washing.
	4.	Installation and environmental hygiene of the mill.
	5.	Back quality used for packing and hygienic care during transport of wheat flour.
Organolaptical	1.	Still the most important aspect of flour is its organolaptical quality.
	2.	Storage of flour and grain.

You can see from the examination sheet that we make for each wheat flour supply from the miller with all the relevant data. In case of deviation a copy goes back to the miller for correction if exceptional release can be given. In case of large deviation the flour will have to be rejected, as the specification is an integral part of the flour supply contract.

In-Line Controls in Mills

I would like to emphasis in-line quality control introduction in flour mills as an standard operation for the following reasons:

1. Quality flour manufacture according to standards avoiding rejections from consumers and loss.

2. Monitoring of moisture for both quality and economic reasons (yield).

3. Milling performance controls to optimize output.

4. Monitoring manufacturing environment to guarantee an early warning system of possible infestation which always results in loss and large costs for elimination and extended stoppage of manufacture.

Let us have a look at what we are talking about in terms of investment for a factory line control aboratory:

Moisture	Rs 40,000	
Dirt	Rs 200	
Ash	Rs 12,000	
Lipase	Rs 200	
Microbiological	Rs 25,000	(can be give to any lab)

With a large mill the investment for an effective line control Lab is very marginal in comparison to the feedback it gives for accurate monitoring of all relevant sectors of milling and the potential savings on manufacturing losses.

Lastly, I would like to show you a graphic we established with the examination data available from flour analyses as a useful tool to discuss milling performance:

1. Dirt is directly correlated to moisture in flour or the washing process prior to milling. It gives a good indication of the operational control.

2. Similarly is the acidity of the flour.

3. Growth of molds is not related to moisture within the above moisture level and variations may indicate variations of grain quality used in milling.

Conclusions

Customers like Nestle-Milkpak are a new sector of the large wheat flour users in Pakistan, insisting on quality but willing to pay a premium price for consistently high standard supplies.

Manufacturing quality flour is primarily an attitude question and improvements have to be made by the millers first. Investment for quality flour is ZERO.

We suggest introducing simple in-line quality controls permitting large saving in yield, operational costs, and costly hygiene control measures in the case of insect infestation.

I would like to thank you for your attention.

GRAIN STORAGE MARKETING AND PROCESSING INDUSTRY PERSPECTIVE

Abdul Ghani Mirza[8]

(Translation from Urdu)

Honorable Joint Secretary and other respected guests:

As my field and profession is flour milling, I would like to confine myself to wheat grain. In fact, the grain storage department is with the public sector, that is why I will not discuss much about this.

It is very important to note that we need a bulk handling system in the future because the government has to bear an enormous expenses on gunny bags subsidy and handling of bags.

In bulk handling you do not need bardana but to adopt this system where to get the initial expenses. These things are causing problems in adopting bulk handling. The existing system of transporting wheat is very bad. You can notice spoilage of wheat from the flatbed trucks carrying wheat from one place to another. This type of waste is national waste which cannot be tolerated. The transportation on high wall flatbed trucks is very difficult for the labor to load the heavy bags.

The developed countries are using machines for such type of laborious work as mentioned by Dr. Maxon. In the USA, handling of wheat and wheat products is done in bulk.

The conclusion which I have drawn during my study tour of America is that, not today, but tomorrow, we have to go towards this system. Some of the flour mills in Punjab have installed their own silos for storage of wheat in bulk to avoid the extra expenses of gunny bags. I would suggest that we should build grain storage near the consumption points to reduce the transportation charges.

Now I would like to mention some problems which the flour mill industry is facing during processing of wheat. As a student of mechanical engineering, I have experience that our engineering university in Lahore does not provide any information about the milling industry. At the University of Agriculture, Faisalabad (AUF) we may find some books relating to agribusiness and milling but the UAF does not have any regular courses in milling. This is very important industry an there should be some independent institution for milling.

The extent of moisture in wheat is about 8% to 12%, but at early harvest it can be 16% to 17%. The moisture increases during tempering which is a very important part of milling. The allowable limit of moisture in flour is 13.5%. The upper limits of moisture beyond that comes in adulteration and we are declared as defaulters.

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[8] Usman Flour Mills, Faisalabad.

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The question is why we do we need tempering? To add moisture the wheat is stored in conditioning bins for about 12 hours. This is very important. Without this it is very difficult to extract maida or fine from the wheat.

After making the endosperm soften, the wheat is milled from first break to fifth break. The purpose is that the bran should not be mixed with the endosperm. We extract maida from endosperm and the presence of bran in maida can downgrade the quality. Without tempering we cannot extract maida or suji. We will get the whole-mill atta from which we cannot separate the bran with any sieve. Atta and maida are both important.

In the flour milling system, the quality of maida at different breaks is not the same as produced at various reductions. What is the reason, we do not know. The UAF should provide training so we may be able to solve our problems.

The corrugation of grinding rolls, whether smooth or Mitchell cut, sharp-to-sharp or dull-to-dull. What should be the different ratio? The solution to these problems is not easily available here. We learn from experience or by the hit and miss method.

There are many flour mills around the university running day and night. These are the best laboratories for the students of UAF. I wish the University of Agriculture, Faisalabad get the same reputation as Kansas State University in the field of grains and milling. Some other problems about grinding and milling can be explained by a technical person.

Another important step in milling is cleaning of wheat. In this process, we are able to remove many impurities. In view of the size of wheat, we put the screens which allow the wheat to pass through. Any material such as big straws, stones, gram, and corn will remain at the top of the screen.

At the second stage of cleaning, we use the round mesh which allows the light particles to pass through. If the size of any particle is about the same as wheat and its specific gravity is the same like barley, how we can remove this from the wheat. These are the problems which surely have some solutions but we, at the moment, do not have an institution to consult and receive guidance.

I would like to mention another thing that USAID started, allocation of foreign training scholarships for the private sector in the past four or five years. We are satisfied with this. Our government does not care to award scholarships and most of the government officers get this chance. The USAID programs will be done by 1994. I would request that the government provide maximum scholarships to the private sector. After foreign training most of the government officers get busy in administrative affairs. This does not bring any productive results. The private sector after foreign training can establish the industry on modern lines.

A long time back, the wheat was ground by hand-held stones and then windmilling took place. Now a complete machinized system of milling with computerized facilities is available in developed countries. It is now the responsibility of the private sector to bring changes in milling industry to this country.

Now at the end I would like to say something about marketing. There are two phases, one is when we buy wheat from the open market, and the other is when wheat is not available at the market. At that time, the government provides us the wheat from reserves. We have to face the different problems at these two stages.

During harvest, wheat is available in surplus and all flour mills try to purchase wheat according to resources. This time is good for the public and private sector for healthy competition. Good quality of wheat is available at a good price. Some quantities of wheat is smuggled to neighboring countries and we face a shortage of wheat.

As the government does not have enough stocks of wheat and it is importing a lot of wheat. The food department is trying to manage the wheat distribution very competently. There is always room for improvement. If there is not enough wheat available for mills, the rates of Atta will be increased. Necessary measures should be taken to avoid the black marketing.

Thank you.

ROLE OF THE PRIVATE SECTOR IN PEST MANAGEMENT OF STORED AGRICULTURE PRODUCE

A. Q. Hasnain[9]

Worthy Minister for Agriculture, Punjab, Ch. Muhammad Iqbal; Dr. Muhammad Rafiq Khan, Vice Chancellor University of Agriculture, Faisalabad; colleagues and friends.

Most of you are aware as to what role the private sector should have on any pest management program. Just to recapitulate it, for record's sake, I will enumerate these to be:

1. Make available to different users a quality product, which

   - controls insects in all stages of development, i.e. eggs, larvae, pupae and adults;
   - can be applied in almost all storage locations;
   - is very simple to apply and handle, without requirement of special equipment, i.e., tubes, scales, etc.;
   - is completely safe for users when applied according to instructions;
   - does not affect quality and flavor of the treated commodity; and
   - is available in various packings, to meet requirements of different users.

The importance of quality control in a manufacturing program needs no emphasis. It builds the reputation of, and confidence in the offered product(s). I consider this an important aspect in the manufacturer's own interest.

We claim to have met the requirements as per above and shall continue to strive more in positive directions.

2. Provide education and training.

Pesticides are poisons, they cannot be used in pest control operations. The same is true of fumigants, as they are also pesticides. The difference being that they should exist in a gaseous state, in sufficient concentration, to be lethal to given pest situation, under required humidity and temperature conditions. Therefore all users of these products need to be supplied with an authentic set of instructions regarding their safe and efficient use.

For education and to update knowledge of various customers periodically, carefully designed training and education programs are also to be a normal

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[9] AG Pesticides (Pvt) Ltd.

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function. This is a two-way program to enhance customer confidence in the use of products and a source of valuable feedback on the performance of products for the manufacturers.

I accept that we could not contribute much in this direction for certain reasons beyond our control, mainly the delay in registration of Pakistan production and imports through other sources, whose main interest was to earn commissions in the tender business and enjoy it until the next opportunity.

We are now looking forward for a real and meaningful cooperation with the Agriculture Extension Service and with the Plant Protection Institute, Faisalabad on their periodically organized training programs for the field staff and farmers and will suggest that members of public-sector agencies such as the Punjab Food Department, PASSCO, and Punjab Seed Corporation are also included in such training programs.

3. Provision of research and education programs.

It should be capable of undertaking directly or in cooperation with capable and competent agencies, problem solving research and education programs.

The genetic diversity distribution of insects is normal in the population of species. This means that some insects are extremely susceptible, others extremely tolerant, while the majority of the insect population falls within a relatively narrow range of tolerance limits to toxicants or other life destroying pressures in their environment. It will be difficult to say with a full degree of confidence that the pesticides have killed the whole pest population in a given situation, for other reasons, e.g., lack of proper gas tightness at locations under fumigation. And, if the dose applied falls below the prescribed level due to any reason, individual insects having a higher tolerance are sure to survive. In-breeding of such surviving pest populations is called "selection" for higher tolerance, which ultimately leads to the development of resistant strains. Due to the generally favorable ambient conditions of temperature for their breeding, coupled with the short life span of insects, and the common use of improper fumigation technique, selection pressure for higher tolerance against hydrogen phosphide gas is bound to have a high occurrence in Pakistan.

Correct dose determination for various sites and situations has to be a continuous activity, both by us and responsible research teams in the government sector.

Scanning the existing world spectrum and looking into a considerable longer-time, period, hydrogen phosphide is the only available fumigant which can serve our present and future needs. If this becomes unusable, we can visualize the awaiting catastrophe both in terms of conservation of our susceptible production during the storage and export earning period.

Agriculture repeats itself annually. Therefore, our production for consumption in the human and industrial sector must necessarily be brought into stores.

I would emphasize and earnestly appeal for immediate recognition of this problem and impending threat to our national economy. And this appeal is presented to

the highest administrative level, cream of our national researchers, and users, in this esteemed gathering.

We would consider ourselves fortunate to be associated and contribute our knowledge and material participation to you, Dear Mr. Vice Chancellor, for an agreed program of research, with the earnest hope that your recommendations are followed by various public-sector agencies.

To tackle the problems, solutions will have to be conceived and field tested in order to:

- determine the C&T factor, particularly on a tolerant population, in different sites and location leading to proper dosage calibration for such situations,

- determine the degree of air tightness in various sites and locations and the methods and means to rectify the defects, and

- determine the importance of ammonium carbonate as an ingredient in the production of an end product with aluminum phosphide.

The safety factor, by the release of ammonia gas as a warning sign, and making the environment inert with the concurrent release of carbon dioxide, are two well known important advantages associated with the use of ammonium carbanate. Indications and pointers are available to know that the concurrent release of carbon dioxide with hydrogen phosphide potentiates the action of hydrogen phosphide. To make the end product completely safe, the addition of ammonium carbonate to the extent of 26%, as in our product, is necessary.

We will be looking forward to participation in your research in these directions and will be happy to meet our obligation in this matter being a national industry, which has not been seen so far.

Sir, at this forum organized by the University of Agriculture, Faisalabad, I take to be a distinguished body dealing with all related problems in agriculture With your permission, I would like to present my thoughts and some facts on yet another important aspect, "manufacturing of pesticides in Pakistan".

We all know that our import bill on pesticides has passed $200 million per year. The rupee cost is now touching Rs 5 billion per annum. These figures can safely be estimated to double themselves by the close of the century and will further increase year after year to cover all important crops up to optimum requirements, besides only cotton.

There are only two possibilities before us; either to reconcile with present and continued future import bill or to examine whether or not pesticides can be manufactured in the country with local raw materials, or with imported raw materials, or a combination of both.

According to the Ministry of Agriculture, manufacturing is possible for more than a dozen pesticides at a foreign exchange savings of up to 80%. This can provide a base for further development in this vital sector and will have something at

hand in times of emergencies. We ourselves, besides manufacturing two pesticides of basic need, namely aluminum phosphide and zinc phosphide, have plans to embark upon a few others.

The question therefore arises as to why this has not been done or cannot be done in the interest of the nation. The answer is simple. It lies in the fact that fiscal, tariff, and administrative policies are heavily tilted in favor of imports of finished pesticides from abroad rather than having a policy on creating an industrial base for pesticides.

Many developing countries, after recognizing this need, have also become net exporters of pesticides.

It is due to be taken note of that almost all important companies, operating on imports in Pakistan, have their basic manufacturing facilities across the border simply because import policies appear to have been presented to them on a silver platter, just for the asking.

The on-going political changes, mainly in central Asia, also call for such a base which, besides catering to domestic needs, can look for exports in these regions.

To substantiate my point, I have to refer to the "New Agricultural Policy" announced on 24th February 1980, which is till in vogue and by virtue of which moratorium on duty free imports was allowed only for three years and this too, only unless any duty and sales tax was to be necessary, to protect local industry. Under this policy, the import of two pesticides, namely BHC and DDT, being manufactured then, was completely banned. This provision of the policy was later also continued in various communications to us.

Today, however, the position seems to be reverse. In a letter dated 11 August 1991, from the Ministry of Agriculture, we have been told and I quote "Your request for encouraging and patronizing local manufacturing of basic pesticides has been noted and will be considered when a policy on the subject is formulated". Sir, even after 44 years of existence, why have we been deprived of national pride in this vital subject? Does the present policy of self-reliance have no meaning on pesticides?

The often spoken argument that providing pesticides free of all tariffs including even octroi, through imports to our farmers is a notable thought, but I am afraid, without any actual assessment, simply because of the following facts:

- It is based on assumptions and not on actual study.

- No entrepreneur will risk investment without considerable savings in foreign exchange to provide pesticides at an acceptable cost to the farmers.

- Our venture to produce a world renowned pesticide is saving up to 80% foreign exchange. The rupee cost is up 100% economical when compared to competitive products of the same specifications, i.e., from Germany. To compete in the rupee cost from sources offering dumping prices and export bonus/incentives is, however, difficult and impossible.

It is a negation of the whole industrial base. Farmers also need other essential requirements of life available to them via established industries having fiscal barrier on imports. Then, what is the fault of other Pakistanis. They may also like to enjoy fiscal barrier free imports of all their requirements, in competition with local industry productions.

We all know that prior to February, 1980, the import and sale of pesticides was done by different public-sector agencies at a subsidy of 50%. For obvious reasons, the import and sale of pesticides was privatized in February 1980. It is a fact that this policy has yielded very positive results in the form of pesticides off-take from Rs 225 million in 1980 to about Rs 5 billion now, an increase of about 1,700%. The impact is well-known in terms of production, mainly of cotton. Although the price difference of 50% subsidy level to the farmers is almost up to 130% more in the present structure.

Fears that this policy, resulting in higher prices, will lead to no off-take of pesticides by farmers were also openly expressed then, but have proven to be absolutely misfounded.

Plant health is no less important than human and animal health, therefore, it should be possible to bring the pesticide manufacturing industry in line with that of the pharmaceutical industry. We know that even gelatin capsules have been allowed duty free imports to fill vitamins, antibiotics, etc.

It is again a matter of record that the privatization policy on import and sale of pesticides was spearheaded by the Punjab Agriculture Department and now on this occasion I would like to mention the name of my colleague, Dr. A.S.K. Ghouri, Ex-DGA (Extension), Punjab, for his relentless effort in this direction.

Similarly, I earnestly and humbly request the worthy Minister for Agriculture, Punjab, to constitute a committee to examine what is possible in this vitally important factor of our national interest; and why this has not been achieved so far.

We shall feel honored and grateful to contribute our bit in such deliberations leading to a formal policy decision.

IMPORTANCE OF GRAIN GRADING

Richard C. Maxon[10]

Grain Grades

Grain grades are a listing of the characteristics or attributes of grains deemed important to the buyer and seller. The buyer wants wheat for a specific purpose; to make atta, maida, animal feeds, etc. Sellers need to convince the buyer that their wheat has the properties needed to make the desired products without undue losses or expense. Grades provide a rapid means of communicating what each wants to buy or sell by summarizing several characteristics in a single letter, number, or word. Grade factors may include variety, moisture content, color, shape and size of kernel, insect damage, etc., as indicators of the suitability of grains for creating end products. All wheat is not created equal for specific purposes (Figure 1).

Grain Grading

Grain grading is the process of measuring specific lots of grains against grade specifications. This can be done by sensory means; biting for moisture content, smelling for molds, insect damage, or visually for foreign materials, brokens, insect damage, etc. More sophisticated and consistent mechanical means are used where grades are enforced.

Why Grain Grading?

A grading system administered by an impartial entity, such as a government agency, offers buyers and sellers a standardized way to evaluate the quality and value of grain. Grading permits transactions to take place by voice or electronic media, without the necessity of personal inspection of each lot. Grains of similar grades can be mixed and transported together, saving handling and distribution expenses. A good, well enforced grain grading system can hold deceptive or fraudulent practices in grain trading to a minimum.

The most valued attribute any product can have is consistency. That is, the atta, nan, chappati, or leavened bread should be the same today, tomorrow, and next week. Progressive millers build their reputation on consistent quality. The baker cannot have surprises or costly failures. The housewife does not want culinary disasters when serving her family - particularly the in-laws.

In Pakistan however, quality control in flour mills and downstream processing are virtually unknown because of the inability to control inputs - hence quality. Every wheat purchase is a virtual "grab-bag" of the good, the bad, and sometimes the ugly. Millers try to compensate the best they can by cleaning, blending, and with equipment adjustments. These hit and miss measures are mostly intuition,

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[10] Chief-of-Party, Food and Feed Grains Institute, Storage Technology Development and Transfer Project.

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based on experience. Very few, perhaps less than five of the nations' 400 plus flour mills have functional laboratories. Even these are not used regularly.

What is Quality?

Wheat quality is usually judged by its suitability for a particular purpose. There are many inherent properties of wheat and exogenous factors that determine whether or not a wheat produces a satisfactory end product. Wheat as produced is not the same wheat as consumed. Between production and consumption, wheat must be stored, transported, cleaned, milled, and processed into forms digestible by the human body.

Botanical Criteria of Wheat Quality

1. Species

   There are many wheat species throughout the world, but only three species have commercial value.

   a. Common wheat (*Triticum aevestium*)

   This variety makes the most suitable flour for leavened breads or loaf breads.

   b. Club wheat (*T. compactum*)

   This is a "soft wheat" that is best for chapatis, nan, biscuits, cakes, and other unleavened products.

   c. Durum wheat (*T. durum*)

   Durum is a "hard wheat" most suitable for pasta products, such as macaroni and spaghetti.

2. Variety

   In Pakistan, about 16 varieties are in common use, but production is concentrated in fewer than six varieties. Provincial governments issue lists of banned varieties because these varieties are low yielding, may promote insects or mold growth that affect other varieties, or for other reasons. In practice, banning of varieties is hard to enforce where farmers save seed from their crops.

Physical Criteria of Quality

The physical characteristics are indicative of end-use value such as milling yield. Processors often pay more for desired characteristics, less for wheat that will require additional costs for cleaning, drying, and sizing, or that will yield less of the desired end products.

1. Weight per unit volume

There is a direct correlation between weight and flour yield. Good quality wheat will weigh about 78 kilograms per hectoliter. Weight per unit volume is an indicator of the moisture content. High moisture content wheat weighs less per unit of volume than lower moisture content wheat.

2. Kernel weight

This is an alternative test of weight per volume. Units of 500 or 1000 sound kernels are weighed and judged by criteria set according to specie and variety.

3. Kernel size and shape

These factors affect milling yield. Milling machines are set to receive wheat of specific sizes. Wheat not within the specified ranges may pass through without being properly milled, clog up machines, and reduce milling efficiency. Resetting machines is too time consuming and expensive to be done for irregular lots of wheat. An alternative is to use machines that separate wheat into lots according to kernel size. These machines involve additional capital, energy expense, and add extra milling steps.

4. Kernel hardness

Wheat is measured for hardness to judge its suitability for products to be made. Wheat of different hardnesses may be blended to get proper milling characteristics. Buyers are often willing to pay more to get a specific hardness to blend with the wheats they have on hand.

5. Vitreouness

This is related to the transparency of some wheat varieties. Vitreouness is roughly correlated with hardness and protein content, thus is a subjective measure of suitability used by some wheat buyers. Protein levels and hardness need to be measured by more objective testing methods.

6. Color

Wheat is classed as red or white, depending upon color of bran. Color is often used as a subjective measure of species and varieties, but newer varieties may cross the distinctions formerly made between red and white wheats. Pakistani consumers are quite sensitive to the color of chapatis. *Desi* wheats are preferred over imported wheats by flour millers because imported wheats may make atta colors not favored by the consumers.

7. Damaged kernels

Kernels that are shrunken, broken, or have insect damage yield less atta and are often removed during cleaning before milling (Annex B). These

materials may have value as animal feed. The mill may be able to sell these for about one-half the price per kilogram paid for whole grain.

8. Foreign matter

Dirt, dust, small stones, weed seeds, straw, and other items that are not wheat accompany wheat as it is received from the producer. In Pakistan, the extraneous materials are frequently called "refractions." These items must be removed before milling.

9. Milling quality

This is an overall assessment of the properties of wheat. Testing for milling quality requires equipment and trained personnel. Where very specific characteristics of end products are required, elaborate testing procedures are often employed. Specialty flour millers often pay more for wheat that meet very precise specifications.

Chemical Measures of Quality

Wheat is composed of organic matter. It is possible to separate wheat into it basic compounds to identify characteristics that affect the quantity and desired attributes of the end products.

1. Moisture content

Moisture content is directly related to the intrinsic value of wheat, and is indicative of its suitability for storage. Wheat must contain less than 12% moisture to be suitable for long-term storage. For milling, water must be added to 13.5% - 15.0% to make flour or atta with good storage characteristics. Tables 2 and 3 show the effect of moisture on milling yield and value.

2. Protein content

Protein content varies with end-use products. Hard wheat products have higher protein levels than "soft" products such as cookies and cake (Figure 1).

3. Protein quality

Proteins are composed of amino acids. Wheat proteins are "incomplete" in when they do not contain all amino acids essential for human nutrition. Mixing atta with edible oils, eggs, milk, etc., and eating chapatis with other foods helps to provide essential nutrients. Wheat varieties vary in the proportions of amino acids. Protein quality also affects the gluten content. Gluten provides the elasticity or ability to stretch without tearing which is essential in making chapatis.

4. Alpha amylase activity

Alpha amylase activity is important in leavened breads. Low alpha amylase is desired so bread will bake without large holes or air-pockets in it.

5. Fat acidity

Fatty acids accumulate in wheat over time. Tests for fatty acids are used to determine if wheat has been properly stored. High levels of fatty acid indicate poor storage conditions and which cause flour products to have bad or off flavors and a short shelf life.

6. Crude fiber and ash

Ash concentrates in the wheat kernel on the outer layer of the endosperm, next to the bran. Excessive levels of ash are indicative of heavy insect infestations which alter the proportions of ash to protein (Annex B). Large amounts of ash create tough, tasteless wheat products. The type of growing season also affects the quantity of ash in a product. Millers will often pay more for wheat that comes from areas having good growing conditions and a lower ash content.

At any one time, each of the above factors may exercise influence on the price processors or consumers wish to pay. Pakistan cannot adopt grades from other countries. It must develop its own based on end-use requirements, varieties grown, and production methods.

Grades in the Marketing Flow

What is important to realize is that the marketing process is a series of concurrent flows (Figure 3). The product (wheat) is constantly moving forward toward the ultimate consumer. The market intermediaries, brokers, agents, processors, wholesalers, retailers, etc., are in essence purchasing agents for their own clientele. They must know what their customers want, and how to recognize it in commodities they buy.

When the product flows forward, it is accompanied by information about its characteristics. This information can be in the form of visual inspection of each lot before purchase, or in product descriptions or grades. In the latter case the buyer must have faith that the descriptions or grades are accurate.

What returns in the flow? Payments and information. In the absence of other information, payments are taken as measures of customer satisfaction. If customers like the commodity, they buy it and pay the market price. No sales, low sales, or reduced price offers mean the consumer (a middleman, processor, or household consumer) do not like certain product attributes. For example, excess foreign materials reduce product yields and increase milling costs, hence grain buyers will refuse to buy or pay less to offset the increase in costs and lower sales value of the end products.

When market signals are interrupted or distorted, such as through government controls or subsidies, marketing systems tend to break down. If the producer

knows the government buyer will take a wide range of qualities at the same price, the natural tendency is to deliver the lowest acceptable quality. Producers are insulated from the ultimate buyer or end user and are unaware of the true value of their product and the willingness of buyers to pay for improved quality. Processors will not invest in systems for producing specialty products without assurance that the raw materials required can be obtained. This is why appropriate grades are important for the producer, marketers, processor, and consumer. Without them, progress is virtually impossible.

Is Fair Average Quality (FAQ) a Grade?

The present FAQ grades originated in the grain exchanges that were common in Lahore, Lylapur, Okara, Multan, and other cities in the 1930's. The FAQ then in use was developed for each exchange for each harvest season. At the beginning of harvest, a committee from the exchange would collect samples from the surrounding area, mix them in a *dara* or heap, then do an analysis for moisture, shrunkens, brokens, insect damage, etc. The result would be described as FAQ for the grain exchange.

FAQ descriptions and samples would be sent to major buyers in distant locations. The buyers would then contact the exchange and order shipments for future delivery. At delivery, the wheat was compared with the FAQ sample. If the buyer was not satisfied that the shipment was FAQ, the grain exchanges had systems for settling disputes. FAQ served the role and function of grades. FAQ provided information that was meaningful and relevant to the buyer and seller, and had legal status for settlement of trade disputes under rules adopted by the grain exchanges.

While the present FAQ standards served well in the past, they are inadequate for the present day (Annex A). The basic FAQ standard is 10% moisture content and 1% foreign materials. Most wheat is harvested at 9% moisture or less. No standardized procedures for grading were developed after the abolition of the grain exchanges. FAQ has no legal status for enforcement under the law. FAQ, at present, consists of guidelines that are subjectively applied. In essence, FAQ is in the eye of the beholder. FAQ is neither fair to the producer or consumer as it fails to reflect the end-use value of wheat.

Table 1 indicates what happens when wheat of varying moisture and foreign matter content is accepted and paid for at the FAQ base price. Tables 2 and 3 show differences in end-use values for the flour miller.

Table 4 shows how a pricing system could be developed to complement an objective grading system. Each producer could be compensated for the amount of usable product delivered according to the standards adopted. This is much more fair and equitable for both the buyer and seller.

Table 4 also indicates the adjustments in buying and storage space required if the objective is to produce a given amount of products. Assume for example, the flour miller wants to mill 10,000 Mt of wheat at 10% moisture content and 1% foreign material before cleaning and tempering. If wheat available on the market is approximately 9.5% moisture and 2.5% foreign material, the miller will need 10 extra kilogram per Mt to compensate for cleaning losses and moisture changes.

Thus he needs to buy 100,000 kilogram additional wheat or 10,100 Mt to meet his requirements.

Note however, the price of 10,100 x Rs 3,169 = Rs 32,006,900 is about the same as for 10,000 Mt meeting exact specifications. The Rs 6,900 difference is due to rounding to whole numbers in Table 4. In commercial practice, a pricing formula would be used to obtain identical results. In many places, an additional discount is applied to compensate for extra costs where grain delivered is below specifications. Costs of delivery, storage, and cleaning 100 additional Mt needs to be considered. Profits and losses in grain marketing are a matter of minute fractions multiplied times huge quantities.

Summary and Conclusions

Adequate grade standards, objective measurements, and impartial enforcement of grades and standards can be beneficial to producers, consumers, processors, and middlemen. Grades can facilitate trade and competition in the marketplace. Products meeting standards are rewarded. Those not meeting standards are penalized. Grades and their enforcement help to "level the playing field" for all concerned.

FAQ has largely lost its meaning for several reasons. Wheat production technology is different. Harvesting has become mechanized. Wheat varieties have changed several times. The STDT surveys have indicated that wheat as produced is superior to the FAQ standards. Producers and middlemen recognize this, and take steps to see that what is sold does meet the FAQ standards more or less. FAQ as practiced encourages corruption and adulteration.

The time is right for change. The varieties have changed. The end uses are different - more breads, pastries, pastas, etc., less chapatis. With increasing interest in quality control, bulk handling, and establishment of academic programs in grain storage, changes are coming.

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TABLE 1

INEQUITIES IN FAQ WITH INADEQUATE GRADING
Per Ton With Varying Quality Specifications

LOT	FOREIGN MATTER PERCENT	MOISTURE PERCENT	USABLE WHEAT (kg) 1/	AMOUNT PAID 2/	ACTUAL VALUE OF WHEAT 3/	OVER/UNDER PAYMENT 4/
A	4.0%	12.0%	948.10	3,000.00	2,844.30	155.70
B	1.0%	10.0%	1,000.00	3,000.00	3,000.00	0.00
C	1.0%	8.0%	1,022.00	3,000.00	3,066.00	(66.00)

1/ Quantity of usable wheat delivered standardized to 1% foreign matter and 10% moisture content.

2/ Assumed support price per ton.

3/ Quantity of standardized wheat times support price.

4/ Actual value minus amount paid.

TABLE 2

WEIGHT GAIN IN KG PER TON WITH 0% FINAL FM
AND 14.5% FINAL MOISTURE CONTENT

Initial FM%	Initial Moisture Content				
	8.0%	9.0%	10.0%	11.0%	12.0%
1.0%	59.95	49.84	39.50	28.93	18.12
2.0%	49.24	39.23	29.00	18.54	7.84
3.0%	38.53	28.63	18.50	8.15	(2.44)
4.0%	27.83	18.02	8.00	(2.25)	(12.73)

TABLE 3

COST PER TON CLEAN GRAIN ENTERING PROCESSING FROM GRAIN PURCHASED AT VARYING FM AND MOISTURE CONTENT

Initial FM%	Initial Moisture Content 8.0%	9.0%	10.0%	11.0%	12.0%
1.0%	2,830	2,858	2,886	2,916	2,947
2.0%	2,859	2,887	2,915	2,945	2,977
3.0%	2,889	2,917	2,946	2,976	3,007
4.0%	2,919	2,947	2,976	3,007	3,039

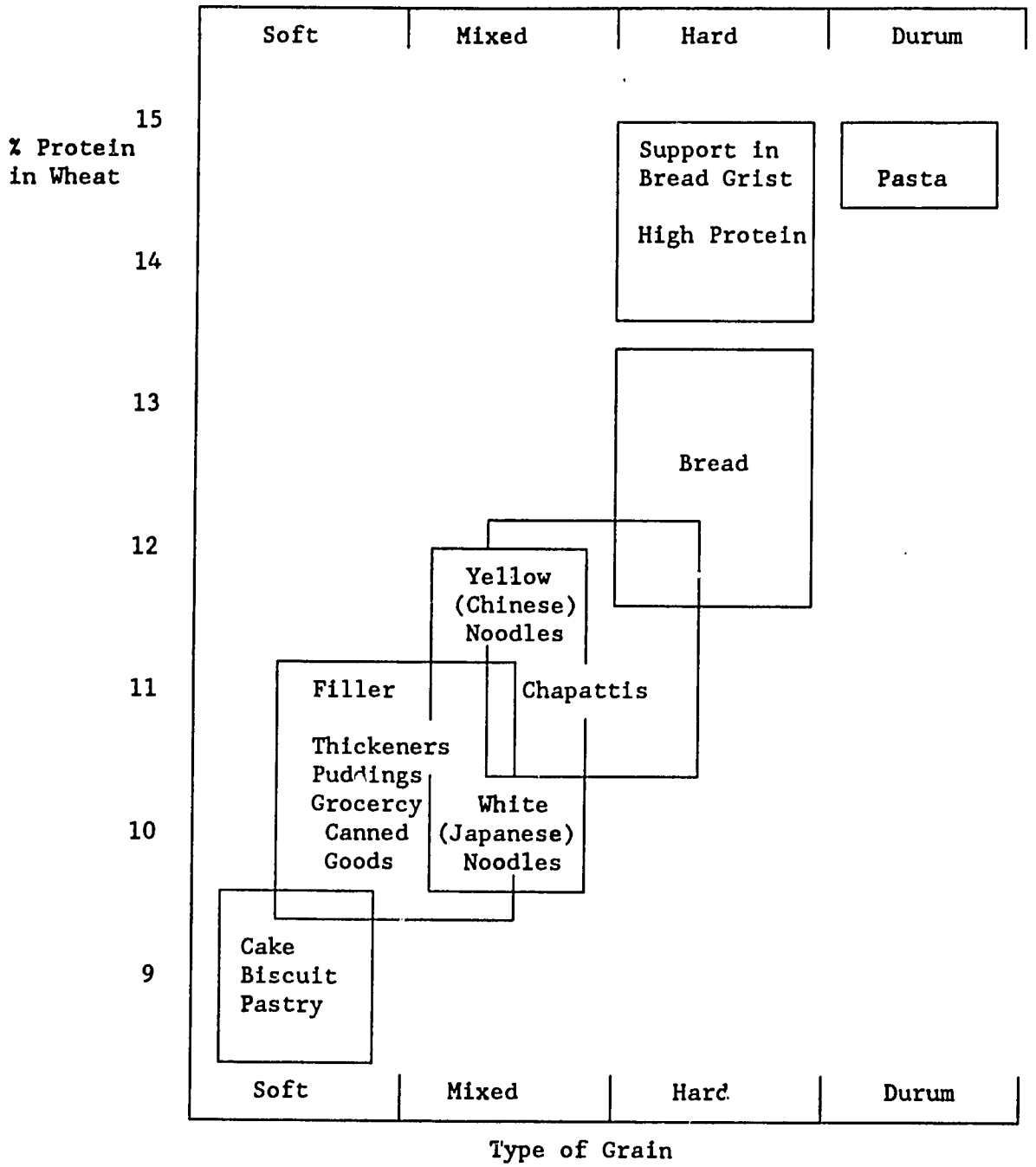
TABLE 4

ALTERNATIVE PRICING TABLE

Conversion of One Ton Wheat as Purchased,
Market Value and Quantity of Wheat Stored at
10% Moisture Content, 1% Foreign Matter

Wheat As Purchased F.M.%	M.C.%	Weight Reduction - Kgs FM/Kg	MC/Kg	Total Wt. Loss	Net Weight	Value @ Base Price Rs 3,200	Qty. Req'd. To Store One Ton
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
3.0%	10.0%	20.20	0.00	20.20	979.80	3,135	1,021
3.0%	9.5%	20.20	(5.56)	14.65	985.35	3,153	1,015
3.0%	9.0%	20.20	(11.11)	9.09	990.91	3,171	1,009
3.0%	8.5%	20.20	(16.67)	3.54	996.46	3,189	1,004
3.0%	8.0%	20.20	(22.22)	(2.02)	1,002.02	3,206	998
2.5%	10.0%	15.15	0.00	15.15	984.85	3,152	1,015
2.5%	9.5%	15.15	(5.56)	9.60	990.40	3,169	1,010
2.5%	9.0%	15.15	(11.11)	4.04	995.96	3,187	1,004
2.5%	8.5%	15.15	(16.67)	(1.52)	1,001.52	3,205	998
2.5%	8.0%	15.15	(22.22)	(7.07)	1,007.07	3,223	993
2.0%	10.0%	10.10	0.00	10.10	989.90	3,168	1,010
2.0%	9.5%	10.10	(5.56)	4.55	995.45	3,185	1,005
2.0%	9.0%	10.10	(11.11)	(1.01)	1,001.01	3,203	999
2.0%	8.5%	10.10	(16.67)	(6.57)	1,006.57	3,221	993
2.0%	8.0%	10.10	(22.22)	(12.12)	1,012.12	3,239	988
1.5%	10.0%	5.05	0.00	5.05	994.95	3,184	1,005
1.5%	9.5%	5.05	(5.56)	(0.51)	1,000.51	3,202	999
1.5%	9.0%	5.05	(11.11)	(6.06)	1,006.06	3,219	994
1.5%	8.5%	5.05	(16.67)	(11.62)	1,011.62	3,237	989
1.5%	8.0%	5.05	(22.22)	(17.17)	1,017.17	3,255	983
1.0%	10.0%	0.00	0.00	0.00	1,000.00	3,200	1,000
1.0%	9.5%	0.00	(5.56)	(5.56)	1,005.56	3,218	994
1.0%	9.0%	0.00	(11.11)	(11.11)	1,011.11	3,236	989
1.0%	8.5%	0.00	(16.67)	(16.67)	1,016.67	3,253	984
1.0%	8.0%	0.00	(22.22)	(22.22)	1,022.22	3,271	978
0.5%	10.0%	(5.05)	0.00	(5.05)	1,005.05	3,216	995
0.5%	9.5%	(5.05)	(5.56)	(10.61)	1,010.61	3,234	990
0.5%	9.0%	(5.05)	(11.11)	(16.16)	1,016.16	3,252	984
0.5%	8.5%	(5.05)	(16.67)	(21.72)	1,021.72	3,269	979
0.5%	8.0%	(5.05)	(22.22)	(21.27)	1,027.27	3,287	973

1/ Assumes wheat cleaned before moisture standardization
2/ (Initial FM% - Final FM%) / (1 - Final FM%) * 1 Ton
3/ (1,000 - Col 3) * ((Initial MC% - Final MC%) / (1 - Final MC%))
4/ Col 3 + Col 4
5/ 1,000 - Col 4
6/ Col 5/1,000) * Support Price
7/ 1,000 * (1,000/Col 5)



Source: R. Carl Hosney, 1986. Principles of Cereal Science and Technology. American Association of Cereal Chemists.

Figure 1. Wheat Types and the Types of Products Made From Them.

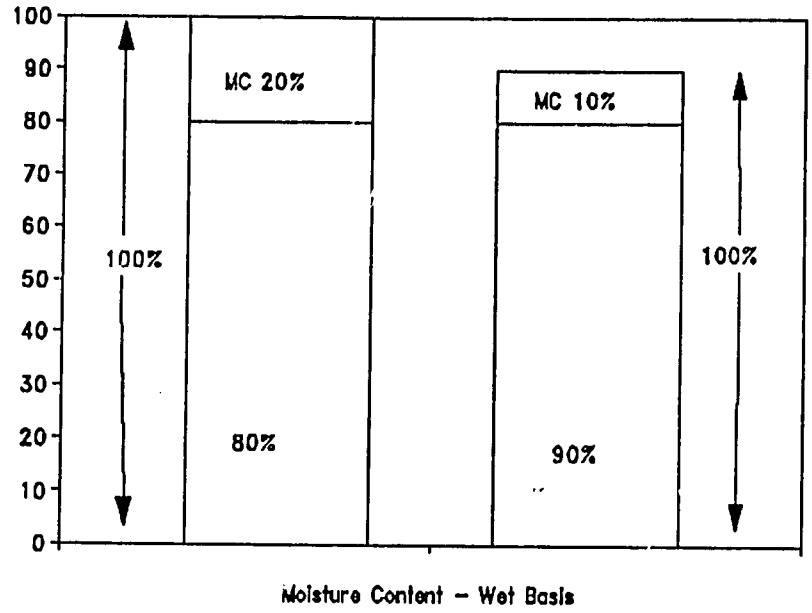


Figure 2. Change in Moisture Content Does Not Affect Dry Matter.

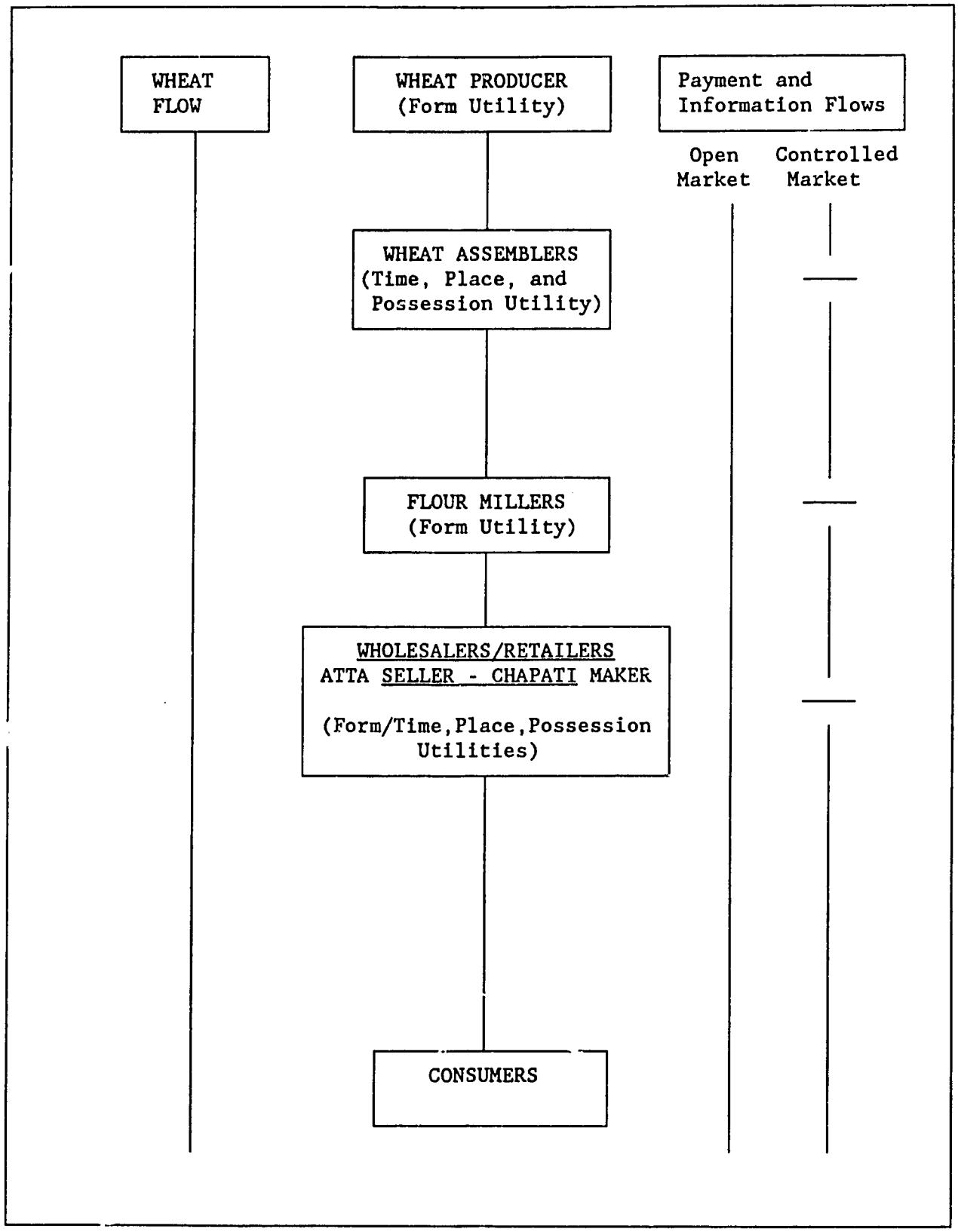


Figure 3. Marketing Flows.[11]

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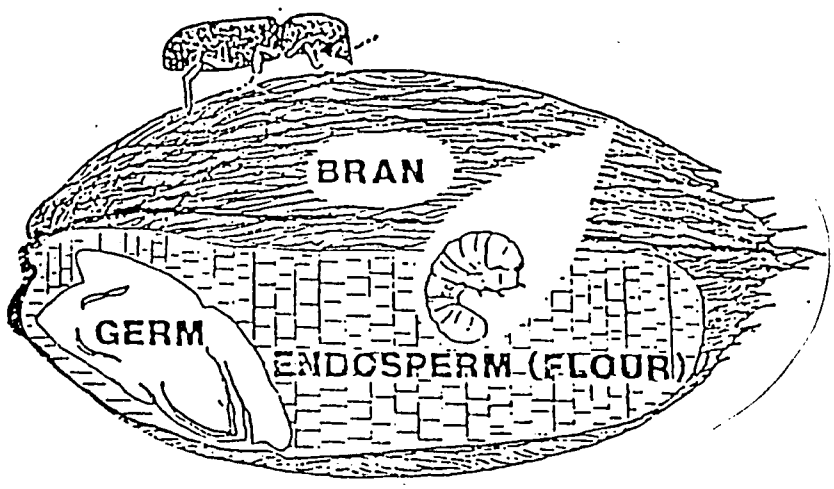
[11] Utility refers to creation of value during production and marketing process. Please refer to any standard marketing text.

ANNEX B

INSECT DAMAGE IN WHEAT



Composition of Kernel	Undamaged	Damaged*
Endospeprm	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 one-third of endosperm removed.

GRAIN QUALITY OF PAKISTANI WHEATS

Faqir M. Anjum and Amjad Ali[12]

Introduction

The quality of wheat cannot be determined by a single character, and is a complex property. Many workers have carried out extensive work on the different quality parameters of wheat. The gluten content and quality produced by any particular genotypes are considered to be important factors in governing the quality of flour (Bushuk and Wrigley, 1974). The bread baking quality increases with increased protein content.

Large dense wheat kernels have a higher ratio of endosperm to non-endosperm than do smaller, less dense kernels (Halverson and Zeleny, 1988). Test weight is the most widely used and simplest wheat quality criteria. In general, the rounder the kernel and the smaller the crease, the higher the test weight and flour yield (Williams et al., 1986). Grain hardness is very often used to classify wheat according to end-use potential (Meppelink, 1974; Symes, 1961).

Flour extraction rate decreases, flour color improves, and flour ash decreases as tempered wheat moisture increases (Butcher and Stenvert, 1973; Hook et al., 1982 a,b). Hard wheats require higher tempering moisture and tempering time to reach prime milling conditions (Hook et al., 1982 c; Stenvert and Kingswood, 1977).

The falling number test has been widely accepted as an indicator of sprout damage in grain (Hagberg, 1960). The extent of starch degradation has a detrimental effect on wheat quality and the effect of sprout damage has been explained by Kozmin (1933).

The objective of the present study was to compare grain quality with American Wheats.

Materials and Methods

Eleven spring Pakistani wheats viz; Pak-81 (PK), Satluj-86 (ST), Punjab-85 (PB), Faisalabad-83 (F83), Faisalabad-85 (F85), Barani-83 (BR), Kohinoor (KN), Blue Silver (BS), V-85054 (V54), C273 (273) and C591 (591) and two American hard white winter wheat cultivars KS84 HW196 (KS) and W81-162 Rio Blanco (RB) were included in this study.

The wheat samples were tested for their physico-chemical, rheological, milling and baking properties. The characters studied were thousand kernel weight, test weight, straight flour yield by using Quadrumate Senior Mill, grain hardness (measured through pearling value, NIR Hardness method, KSU hardness tester and Particle Size Index (PSI)), protein contents, gluten contents, falling number,

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starch paste characterization through Rapid Visco Analyzer (RVA), physical dough test by Brabender Farinograph, and bread baking quality through straight dough method.

Results and Discussion

The kernels per unit weight is a useful index for potential milling yield (Halverson and Zeleny, 1988). The thousand kernel weight of different wheat cultivars is presented in Figure 1. It is obvious that Pakistani wheats are far ahead in thousand kernel weight as compared to American wheats. The present investigations suggest that Blue Silver and Faisalabad 85 with highest kernel weight may be used as a source for improving cultivar kernel size.

There are very little differences in test weight of Pakistani and American wheat cultivars (Figure 2). The test weights for different wheat cultivars indicated that, by U.S. standards provided for all other classes and subclasses except hard red spring and white club wheats, Pakistani wheats may be classed as No. 1 wheats. All Pakistani wheats had test weights more than 60 lbs per bushel, indicating suitability for good milling yield (Halverson and Zeleny, 1988).

Grain hardness was determined by different methods including pearling value, PSI, hardness by NIR, and hardness by KSU hardness tester. The results are depicted in Figure 4. Most of the Pakistani wheats showed higher values than American wheats. From Figure 3, it is concluded that Pakistani wheat cultivars are all hard, based on the classification suggested by Williams et al. (1986).

Straight grade run flour yield of all cultivars ranged between 60% - 70%, indicating non-significant differences (Figure 4). It confirms that test weights above 60 lbs per bushel have relatively little influence on flour yield (Halverson and Zeleny, 1988).

Protein and gluten contents of different wheat cultivars are presented in Figure 5. It shows that all the cultivars have similar protein contents but differ significantly for gluten contents. Faisalabad 85 and V85054 were at par with Rio Blanco for gluten contents while other Pakistani wheats showed lower gluten contents.

Falling number is a rapid method to measure the enzyme activity caused by sprouting. The falling number values of wheat cultivars are presented in Figure 6. The present work showed higher falling number (lower alpha amylase activity) in Pakistani wheats as compared with American wheats, and warrants malt addition for optimum bread production.

Figure 7 shows starch paste characterization of Pakistani and American wheat cultivars. Pakistani wheats showed higher values for cooking (peak viscosity), strengthening (visc. 12 minutes) and set back viscosity (visc. 20 minutes) as compared to American wheats.

Most of the Pakistani wheats showed similar bread baking quality scores to that of American cultivars (Figure 8). Since no oxidizing agent was used in bread baking, and doughs were mixed for a constant time, these could be limiting

factors in reflecting optimum bread quality potential of a flour. However, the relative differences among samples are still apparent.

Conclusions

The present investigations suggested that all Pakistani wheats are higher in kernel weight and test weight as compared to American wheats. The hardness of Pakistani wheats were at par with American hard white wheats. Falling number and starch paste characterization results revealed that Pakistani wheats have less alpha amylase activity, which shows that malt should be added during bread baking processes. Protein content in American wheats was higher than Pakistani wheats. The bread baking quality of some Pakistani wheats is similar to American wheats. In a nut shell, the findings of the present investigations suggest that the Pakistani wheats are at par or better in some characteristics as far as grain quality is concerned as compared to American wheats.

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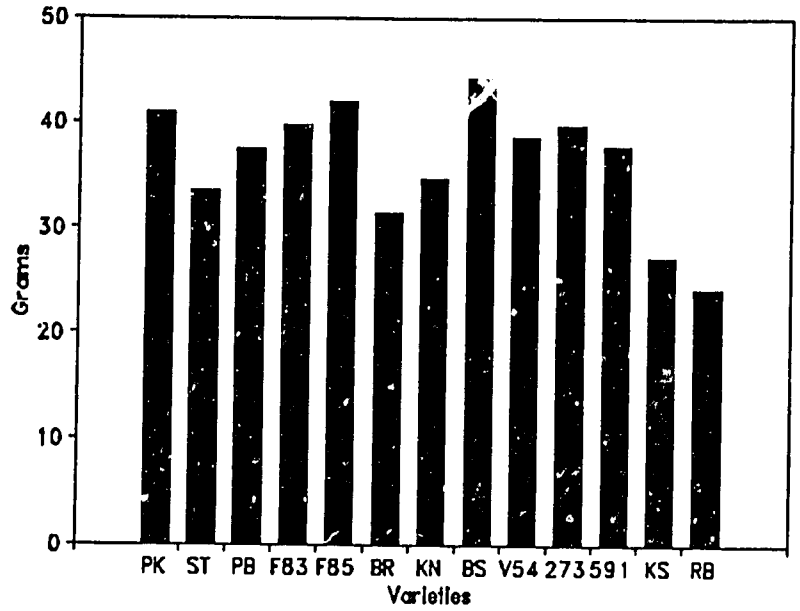

Figure 1. Thousand Kernel Weight of Wheats.

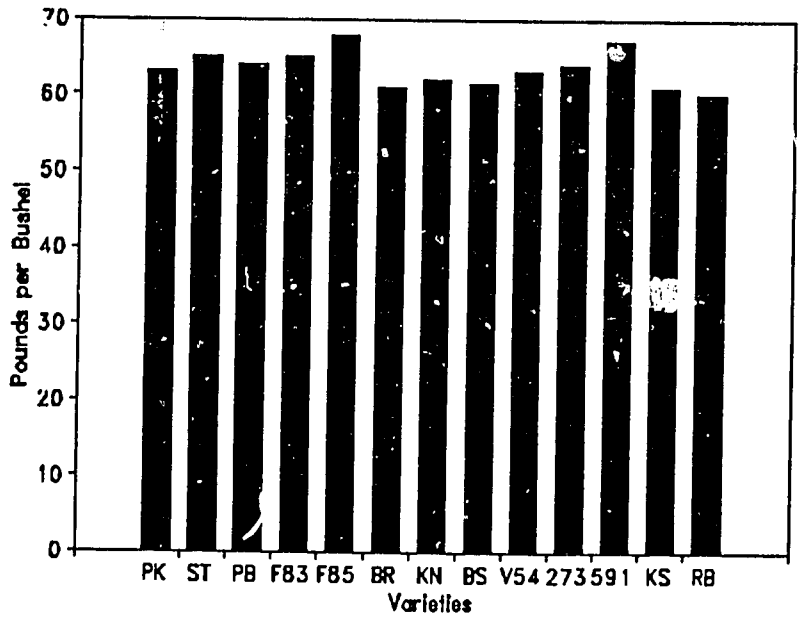

Figure 2. Test Weight of Wheat Cultivars.

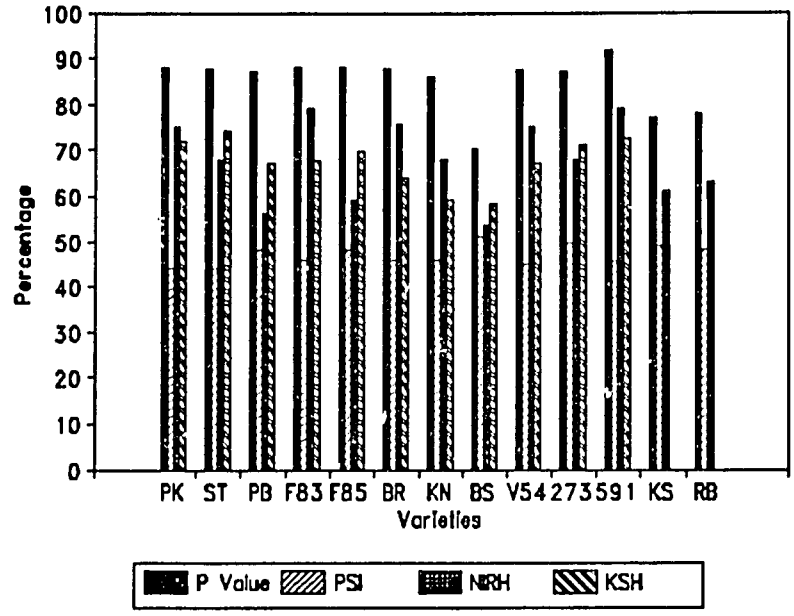

Figure 3. Grain Hardness of Weight Cultivars by Different Methods.

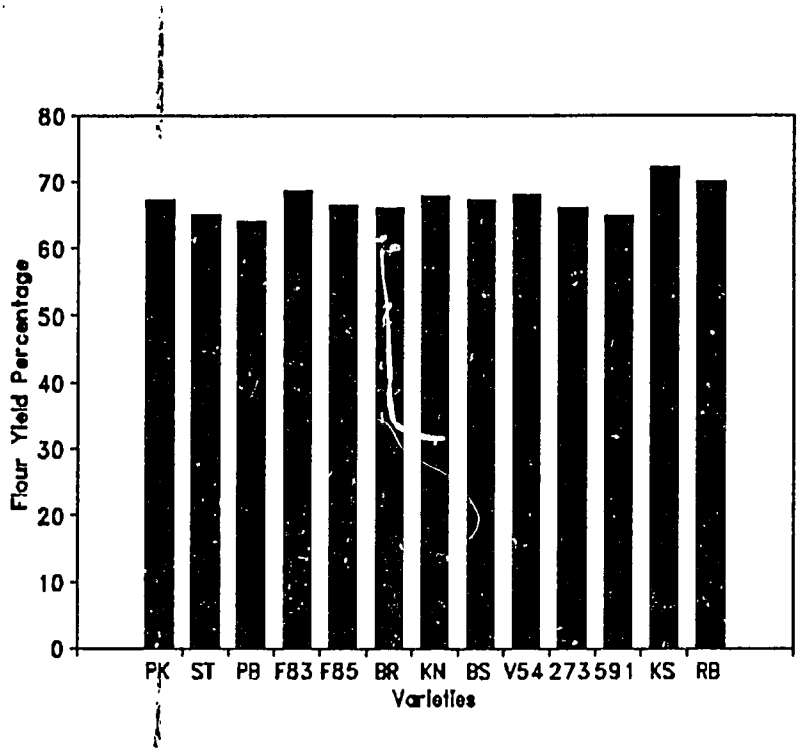

Figure 4. Straight Grade Run Flour Yield of Wheat Cultivars.

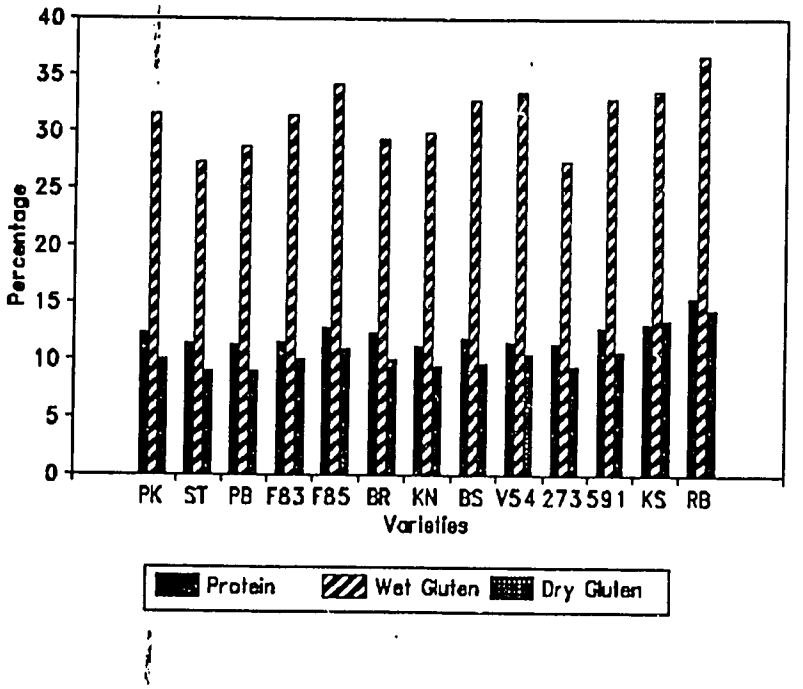

Figure 5. Protein and Gluten Contents of Wheat Cultivars.

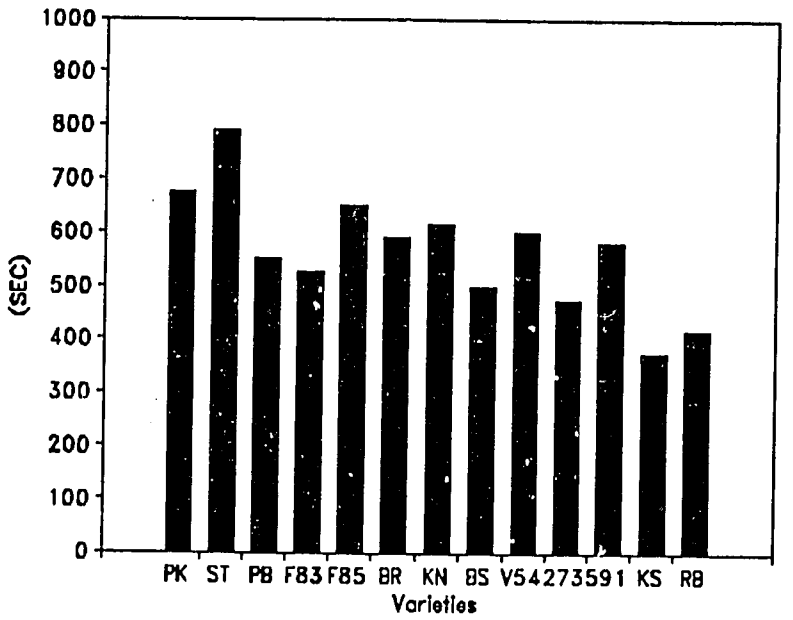

Figure 6. Falling Number of Wheat Cultivars.

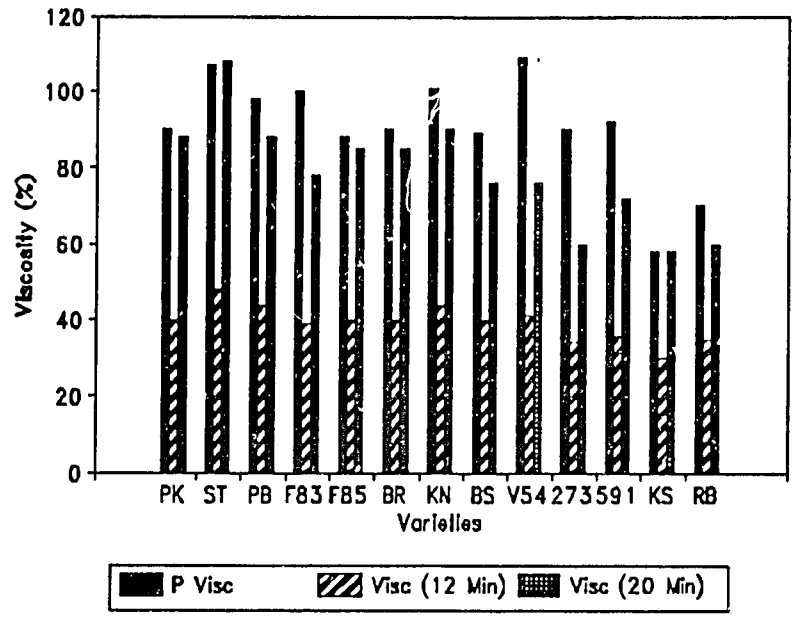

Figure 7. Starch Paste Characterization of Wheat Cultivars by RVA.

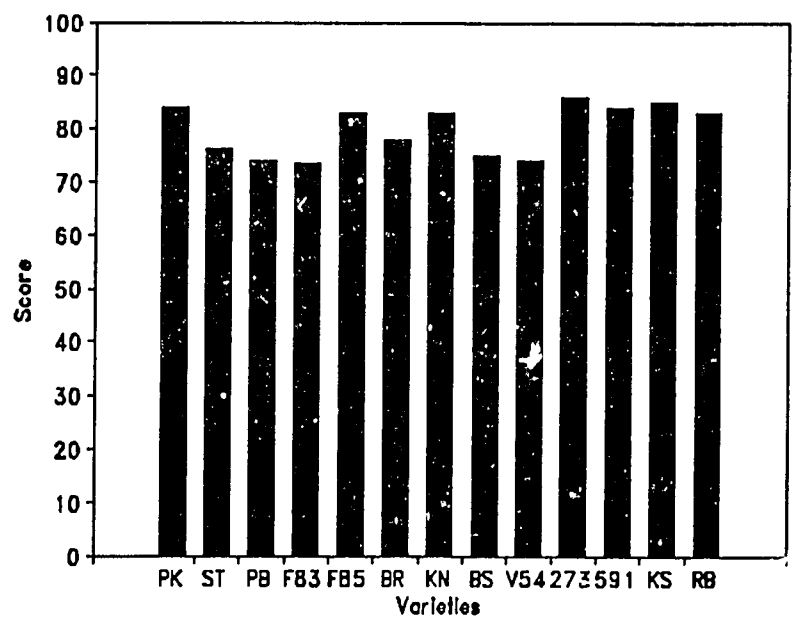

Figure 8. Bread Baking Quality Score of Wheat Cultivars.

MANAGEMENT OF PHOSPHINE RESISTANT INSECTS IN VERTICAL SILOS

Mohammad Sajjad[13]
Tariq Mahmood
Mohammad Asif Javaid
Muzaffar Iqbal

Introduction

Food handling agencies store procured wheat in two forms: bagged and bulk. For bulk storage Pakistan Agricultural Storage and Services Corporation (PASSCO) and Provincial Food Departments (PFD's) use different types of storage facilities. These include house type godowns, hexagonal bins, open bulkheads and vertical silos. In house type godowns, PASSCO uses bag cum bulk storage system. The total volume of such storage in Pakistan is about 450,000 Mt. The PFD's own all hexagonal bin complexes in the country. Each hex bin can hold about 36 Mt of wheat and a cluster of bins hold about 3,000 Mt. Total storage capacity of these bins is about 303,000 Mt in the country. Open bulkheads are newly built facilities for the storage of bulk wheat. There are about 31 bulkheads so far in existence in Pakistan; 21 in the PASSCO and 10 in the Punjab Food Department with a combined storage capacity of 150,000 Mt.

The vertical silo is a very useful and modern facility for bulk wheat storage. Such types of storage facilities are popular in most of the developed countries. As attempts are being made to amplify the bulk handling and storage of wheat in Pakistan, the silo can play an important role as a bulk storage facility. The vertical silos situated at Khairpur and Chichawatni are owned by PASSCO while those present at Multan belong to the Punjab Food Department. NLC built silos in Quetta but are not presently in use because of technical problems. More silos are under construction in Faisalabad and Karachi. The present total silos storage capacity in the country is about 302,000 Mt.

Insect management in bulk grain storage has attracted little attention in the country. Many people believe that insects mostly breed in the top layers of the bulk grain. They consider surface treatment sufficient to control insect infestation. These include insecticidal sprays or some form of fumigation.

Recently, many researches have focused their attention and effort toward the improvement of pest control strategies in bulk grain storage. A collaborative research program between the Storage Technology Development and Transfer (STDT) project and Pakistan Agricultural Research Council (PARC) is an example of these efforts. They examined prevailing pest control methods were found ineffective and developed new and practical pest management procedures for hexagonal bins and open bulkheads. They also studied insect management problems in vertical silos under this program. The common method in use for grain protection in silo is phosphine fumigation. However, the improper procedure of aluminum phosphide (AlP) tablet application and inadequate gas-tight situations in the silos

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[13] Pakistan Agricultural Research Council.

normally lead to failure or partial success of this pest control method. In most of the developed countries, automatic pellet dispenser are in use to dispense the AlP pellets during the loading of silos. In Pakistan, all of the silos also have such types of pellet dispenser for phosphine fumigation. However, managers seldom use these because of two major constraints. One constraint is that the pellets are not generally available in the country. The second, is that the silo is not filled up all at one time due to unpredictable deliveries of wheat. Under these circumstances, phosphine fumigation is not possible during the loading operation. The present study was conducted to evaluate the effectiveness of current phosphine fumigation and to test methyl bromide as an alternative fumigant to control the insect infestation of wheat stored in the silo.

Materials and Methods

Materials required include:

1. Concrete silo filled with wheat.
2. Aeration fan.
3. Grain sampler.
4. Sample bags.
5. Methyl bromide cylinders.
6. Methyl bromide application tubing system.
7. Methyl bromide meter.
8. Weighing scale.
9. Nylon capillary tubes.
10. Sieve set.
11. Controlled temperature and humidity room.
12. Glass jars.

Following is a detailed procedure:

Grain sampling

The PARC/STDT team conducted the study at the PASSCO silo complex, in Chichawatni and used one silo filled with wheat. The height of the silo was about 22 meters (72 feet) and its diameter was 8.5 meter (28 feet). The total storage capacity of a silo is 3,000 Mt but the silo under study contained only 2,600 mt of wheat. The effectiveness of fumigation was determined by the presence of live and dead insects in the samples drawn from the different depths of grain bulk. Grain samples were drawn before and after each fumigation with the help of Gilbert's probe (Figure 1). This grain probe was developed by Garry Gilbert, consultant, Food and Feed Grains Institute (FFGI), Kansas State University (KSU). The probe consists of four parts: (1) vacuum pump, (2) corrugated flexible pipe, (3) grain collector, and (4) steel pipes. The vacuum pump is the basic unit of the probe, mounted on a trolley and driven by a 5 horsepower petrol engine. It has a grain cyclone equipped with a Y-valve serving as discharge outlets. The cyclone, further connected through corrugated flexible pipe with another small cyclone called a grain collector. The grain collector had a discharge spout for grain samples. The fourth unit of grain probe is comprised of steel pipes. Each pipe is 1.13 m. long with an inside diameter of 3 cm. The pipes have interlocking system for quick connective purpose. The first pipe had perforations up to 35 cm from one end. A small length of flexible pipe linked the steel pipes with

grain collector. A worker pushes the perforated pipe followed by other pipes up to the required depth. The pump creates a negative pressure and sucks the grain through the open end of the pipe. The perforations on the first pipe assist in the suction process. The grain samples collects at the grain collector, discharge into sample bags by opening the flap.

Insect monitoring

Grain samples were drawn from each tube length (1.13 m) of wheat depth up to the bottom of the silo from three different points. These points were 0.5 m, 2 m and 4 m from the wall. The grain samples (each weighing about 1 Kilogram) were kept in polyethylene bags, labeled and analyzed in the laboratory for presence of live and dead insects. After separating the live and dead insects, each sample was incubated for 4-5 weeks at temperature 30C ± 2C and humidity 65% ± 5% to observe the survival of eggs or pupae. The presence of live and dead insects in the samples indicated the success or failure of fumigation operation respectively. For simplicity only the live insect data of each three consecutive layers was averaged and presented in Tables 1 to 3. Tables 1 to 3 also show the appearance of insects after incubation and total number of live insects per kilogram sample.

Phosphine fumigation

In September 1991 the PASSCO staff carried out phosphine fumigation in the silo. They used a total number of 3,994 AlP tablets for the fumigation. They placed about 3,200 tablets on the grain surface, and threw the rest in the aeration duct at the bottom of the silo. They sealed the ventilators, manhole, and aeration duct by wrapping with polyethylene sheets. The PARC/STDT team collected grain samples after 25 days from the date of application of fumigant to determine the effectiveness of fumigation. Grain samples came from pre-determined depths.

Methyl bromide fumigation

The methyl bromide fumigation experiment occurred in December 1991 using the same silo. The dose was calculated on the basis of volume and quantity of wheat stored in the silo using the following formula:

Methyl bromide required (gm) = S x total volume of enclosure +
M x tonnage of grain.

Where S = Space dosage (10 for wheat)
M = Commodity dosage (20 for wheat)

Because of higher specific gravity than air, the fumigant was applied from the top of the silo through a distribution system shown in Figure 2. This system was fixed 2 meters above the grain surface in the silo. The nozzles were adjusted in such a way that the fumigant could not come into contact directly with the grain. A total of 96.16 kg (212 pounds) liquid methyl bromide was utilized in this fumigation. The aeration fan at the bottom of the silo was run briefly after 6 hours of application for forced circulation of methyl bromide gas. The gas was retained in the silo for about 48 hours. A methyl bromide detection meter (Bedfont Technical Instruments Ltd. UK) recorded the gas concentration. After 48 hours retention period, the gas was vented out through the roof ventilators,

manhole on top, and running the aeration fan. The aeration was done for three days with intervals of 3-4 hours.

Results and Discussion

The sampling done (August 1991) before phosphine fumigation showed the dominant population of Rhizopertha dominica at all sampling depths followed by Tribolium castaneum and Trogoderma granarium (Figure 3). The maximum population of all species was concentrated on the grain surface and decreased with depth of the grain mass. Live Trogoderma granarium were present mostly on the surface up to first 12 feet layer. They were also present (in small numbers) at the bottom zone where the aeration ducts were. Tribolium castaneum distributed themselves in about all depths in varying numbers (Table 1). The phosphine fumigation dosage rate was one tablet per cubic metre which is the normal recommended dosage. Data in Table 2 show the partial success of phosphine fumigation, because live insects were active throughout the grain depth. However, the number was comparatively less than that before fumigation. The population of Rhizopertha dominica and Tribolium castenum decreased significantly while, Trogoderma granarium increased in number at all grain depths, especially on the grain surface (Figure 4).

The survival of insects after phosphine fumigation may be due to the acquisition of tolerance against phosphine. The studies in the laboratory to control the Chichawatni strains indicated that a phosphine concentration of above 200 ppm is required for 12 days to control Trogoderma granarium. Other species required only 5 days for control. The distribution and survival of insects in different grain layers indicated the inadequate concentration and exposure time to phosphine gas. The results demonstrated that phosphine gas could control only the most susceptible strains but it failed to control the resistant ones. Placing of AlP tablets in the aeration ducts proved useless as it could not control the insects in the bottom parts of the silo. It seems that phosphine gas generated in the aeration ducts leaked out through the aeration system very soon after the application and created a haven for the surrounding insects.

The Chichawatni silos were constructed in 1983-84 and has been in use for wheat storage since that time. The only procedure adopted to disinfest the grain was phosphine fumigation by pre-described manner. This method of fumigation proved to be a failure. The sealing of the structure was inadequate, thus made it difficult to maintain the required gas concentration. It also caused selection pressure on the insect species which developed high tolerance to the toxic action of this gas. This is commonly referred to as the "acquired resistance" to phosphine. The insects that survive in such operations can only be those which have relatively higher tolerance to phosphine. The survivors of further operations will thus become even more tolerant. Such selection will ultimately lead to in the development of strains which may have hundreds of times more resistance to this gas than their ancestors. The development of resistance in insects is much faster because of their short life span compared with higher forms of animals. The adverse effect of the appearance of resistant pest strains is the increase in the cost of pest management. It will require higher dosage levels and repeated fumigations process to control such pests. A more serious implication of the problem is making the fumigant useless as pest management tool. There will be no available substitute having similar properties to combat

the pests. To retain the effectiveness of phosphine for as long as possible, alternate methods of grain protection are highly desirable. This becomes more pressing in situations where pests are resistant against phosphine. The complete control of resistant insects will help in making phosphine gas effective again in disinfecting stored grains. One way of achieving this objective is by maintenance of lethal levels of phosphine gas in the fumigated space over comparatively longer period. Another is to employ other insecticides or fumigants as grain protection agents. The former is only possible in structures having high degree of gas-tightness like polyethylene enclosures. In non gas-tight situations, phosphine will fail to achieve successful control of the resistant insect populations. Application of grain protectants at the time of loading, such as in bulk storage is an alternative solution but chemical residues and other factors restrict their use.

A proven method of controlling phosphine resistant pest is by Methyl Bromide Fumigation. All phosphine-resistant strains are susceptible to this fumigant. Methyl bromide has demonstrated its effectiveness in disinfecting most agricultural commodities since its introduction in the market. The relatively shorter exposure period compared with phosphine is its major advantage. However, it is more difficult to apply and its sorption behavior are the two major disadvantages of this fumigant. Methyl bromide is a colorless, odorless and non-flammable gas at ordinary temperature. A lachrymal agent (chloropicrin) in the fumigant makes it easy to detect leakage or presence of the gas. It is mostly used for quarantine treatment and in situations where less time is available. The methyl bromide fumigation can be a tool to break the phosphine resistance in insects. Resistance to this compound has not yet been reported in Pakistan. The methyl bromide is a low-boiling point fumigant. It is available in the market as liquid under pressure in cylinders. The basic properties of this fumigant are as under:

Formula:	CH Br
Molecular Weight:	95
Boiling point (C):	3.6
Specific gravity (gas):	3.40 air = 1.0
Conversion factor (gm to ppm) at 30 C 1 atm:	260
Flammability limits in air (v/v):	13.5 - 14.5 %
Solubility of liquid in water (v/v):	1.4

After partial success of phosphine fumigation in present study, the control of surviving resistant insects was highly desirable. This is to arrest the spread of insect resistance and to retain the effectiveness of phosphine for future use.

Grain sampling was done before and after methyl bromide fumigation to determine the presence of any live insects. Live insects were present throughout the grain mass in all vertical layers before fumigation (Table 3). The population of three major species was highest on the grain surface and much less after 1-12 feet grain layer (Figure 5). Trogoderma granarium was found more dominant than the other species in nearly all sampling zones. Visual observation inside the silo showed, clusters of live Trogoderma granarium larvae on the peripheral region of the grain surface. They were also crawling on the walls of the silo.

After ensuring the complete removal of gas from the silo, grain samples were drawn from all depths to confirm the effectiveness of fumigation. Wheat samples were analyzed in the laboratory for live and dead insects immediately after arrival and after 4-5 weeks incubation period. No live insects were found in both analyses which indicated the success of methyl bromide as fumigant (Table 4).

Conclusions

Methyl bromide fumigation can provide a successful control of phosphine resistant strains of stored grain insect pests. However it can not be a complete substitute for phosphine due to the following reasons:

a. It needs careful planning of application and complete ventilation after fumigation.

b. The fumigation process requires highly trained and experienced persons.

c. It is marketed in heavy pressurized cylinders, and therefore difficult to transport.

d. The gas is heavier than air and required forced mixing within the enclosure.

e. The application of methyl bromide requires proper distribution system.

f. It can chemically react with the commodity and form toxic bromide residues if not vented out properly.

g. It affects the germination of seeds.

h. The treatment with methyl bromide cost 3 times as phosphine.

Recommendations

Under these circumstances, methyl bromide fumigation can only be recommended in situations where phosphine proves ineffective due to the development of resistance in insects. In locations where such resistance has been detected, the insects should be controlled with methyl bromide fumigation once and then normal phosphine fumigation should carried out.

Acknowledgments

The authors are highly grateful to Dr. U. A. Acasio, Long-Term Advisor and Dr. R. C. Maxon, Chief of Party, STDT project for their keen interest throughout the study.

TABLE 1

NUMBER OF LIVE INSECTS/KG OF WHEAT SAMPLES DRAWN FROM DIFFERENT DEPTHS BEFORE PHOSPHINE FUMIGATION

Sampling Depth (feet)	Trogoderma granarium			Tribolium castaneum			Rhizopertha dominica		
	Before Incubation	After Incubation	Total Survival	Before Incubation	After Incubation	Total Survival	Before Incubation	After Incubation	Total Survival
Surface	6.52	12.61	19.13	5.91	26.51	32.42	2.81	159.10	161.91
1 - 12	0.73	0.22	0.95	1.12	0.71	1.83	1.27	194.70	195.97
13 - 24	NIL	NIL	NIL	0.11	8.58	8.69	0.29	32.15	32.44
25 - 36	NIL	NIL	NIL	0.16	9.21	9.37	NIL	46.95	46.95
37 - 48	NIL	NIL	NIL	NIL	NIL	NIL	NIL	15.51	15.51
49 - 64	0.12	0.16	0.28	0.77	0.12	0.89	NIL	17.66	17.66

TABLE 2

NUMBER OF LIVE INSECTS/KG OF WHEAT SAMPLES DRAWN FROM DIFFERENT DEPTHS AFTER PHOSPHINE FUMIGATION

Sampling Depth (feet)	Trogoderma granarium			Tribolium castaneum			Rhizopertha dominica		
	Before Incubation	After Incubation	Total Survival	Before Incubation	After Incubation	Total Survival	Before Incubation	After Incubation	Total Survival
Surface	140.71	85.34	226.05	7.96	NIL	7.96	4.34	12.88	17.22
1 - 12	0.92	2.00	2.92	NIL	NIL	NIL	0.25	5.69	5.94
13 - 24	NIL	0.24	0.24	NIL	14.00	14.00	0.22	1.18	1.40
25 - 36	0.23	0.24	0.47	NIL	0.95	0.95	NIL	0.47	0.47
37 - 48	0.14	NIL	0.14	NIL	NIL	NIL	NIL	0.95	0.95
49 - 64	2.07	1.18	3.25	NIl	0.24	0.24	1.92	12.10	14.02

TABLE 3

NUMBER OF LIVE INSECTS/KG OF WHEAT SAMPLES DRAWN FROM DIFFERENT DEPTHS BEFORE METHYL BROMIDE FUMIGATION

Sampling Depth (feet)	Trogoderma granarium			Tribolium castaneum			Rhizopertha dominica		
	Before Incubation	After Incubation	Total Survival	Before Incubation	After Incubation	Total Survival	Before Incubation	After Incubation	Total Survival
Surface	1055.19	48.33	1103.52	117.07	24.69	141.76	5.13	9.93	15.06
1 - 12	13.94	0.94	14.88	0.29	NIL	0.29	NIL	0.31	0.31
13 - 24	0.23	0.31	0.54	NIL	NIL	NIL	0.09	0.31	0.41
25 - 36	0.19	NIL	0.19	NIL	0.31	0.31	0.22	NIL	0.22
37 - 48	0.20	NIL	0.20	0.10	0.16	0.26	NIL	NIL	NIL
49 - 64	0.57	NIL	0.57	NIL	NIL	NIL	0.07	NIL	0.07

TABLE 4

NUMBER OF LIVE INSECTS/KG OF WHEAT SAMPLES DRAWN FROM DIFFERENT DEPTHS AFTER METHYL BROMIDE FUMIGATION

Sampling Depths (feet)	Trogoderma granarium		Tribolium castaneum		Rhizopertha dominica	
	Alive	Dead	Alive	Dead	Alive	Dead
Surface	NIL	1863.35	NIL	235.03	NIL	31.77
1 - 12	NIL	144.42	NIL	1.20	NIL	1.73
13 - 24	NIL	13.33	NIL	NIL	NIL	1.00
25 - 36	NIL	9.90	NIL	NIL	NIL	0.40
37 - 48	NIL	28.33	NIL	0.80	NIL	NIL
49 - 64	NIL	47.62	NIL	0.42	NIL	0.62

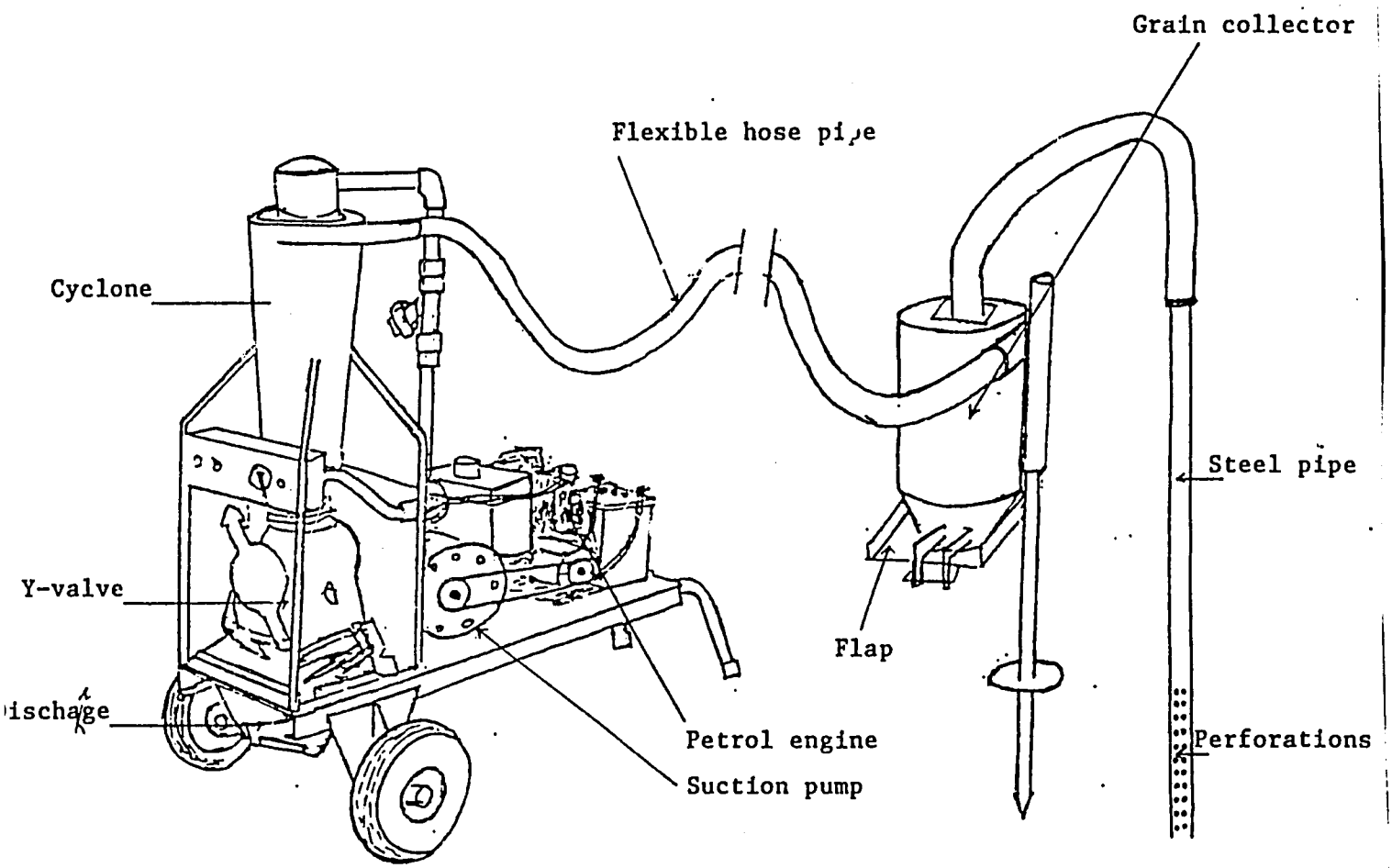

Figure 1. Gilbert's Probe.

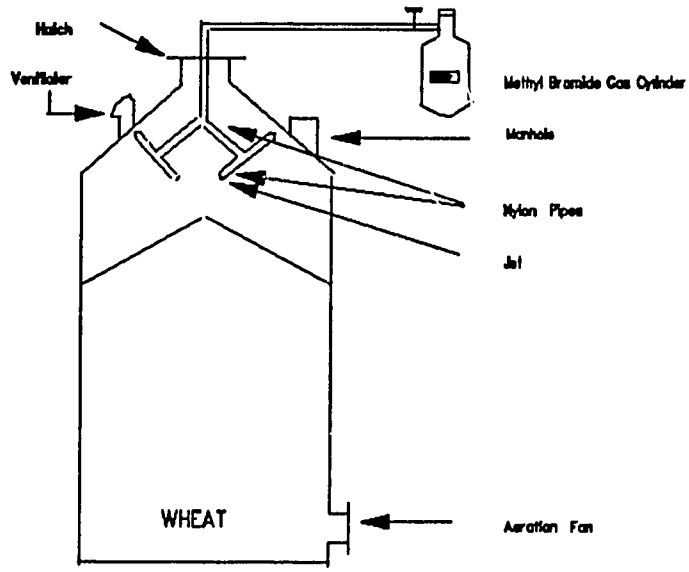

Figure 2. Concrete Silo Showing Methyl Bromide Application System.

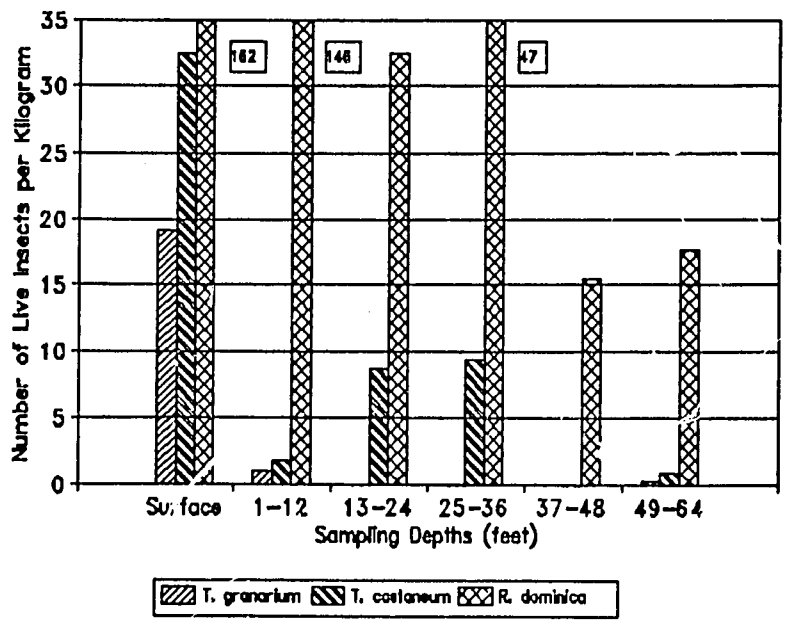

Figure 3. Number of Live Insects/Kg at Different Depths Before and After Phosphine Fumigation.

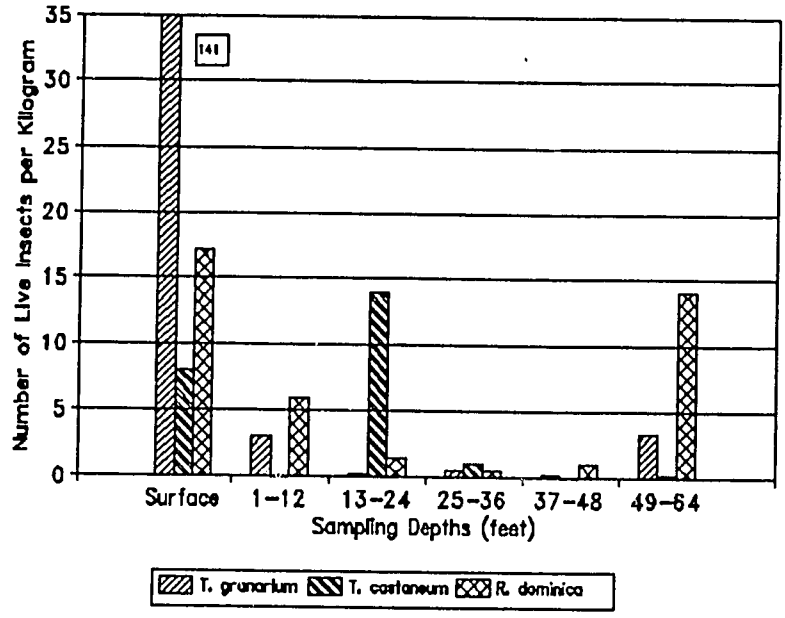

Figure 4. Number of Live Insects/Kg at Different Depths Before and After Phosphine Fumigation.

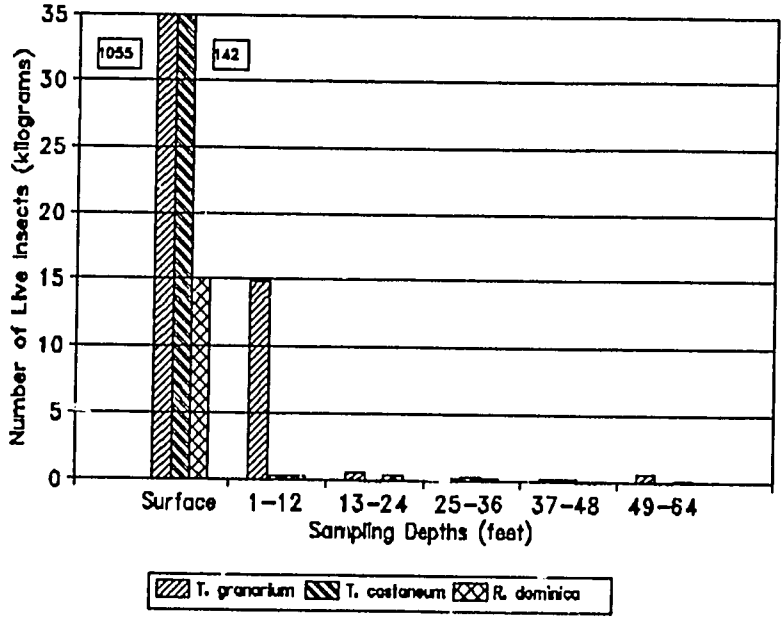

Figure 5. Number of Live Insects/Kg at Different Depths Before Methyl Bromide Fumigation.

A SIMPLE TECHNIQUE TO DETERMINE PHOSPHINE DOSAGE FOR RESISTANT STORED GRAIN INSECT PESTS

Tariq Mahmood[14]
Mohammad Sajjad Ahmad
Mohammad Asif Javed
Muzaffar Iqbal

Introduction

Phosphine fumigation has become the popular choice of control measure for stored grain insect pests in Pakistan and many other countries. Ease of application, relatively low cost, freedom from residues and relatively safe at the time of application are its most attractive features. On the other hand, it has the drawback that insect pests of stored grain can develop high resistance against its lethal action fairly easily when low (sub-lethal) phosphine dosage is continually used at a particular grain storage site over a period of time. Low phosphine dosage commonly occurs when less than essential length of exposure to phosphine is given or enclosure used for fumigation is excessively leaky. Unfortunately, the wide use of this fumigant under these unbefitting environments, was not associated with the proper research and training to monitor its possible consequences on insects. Repeated and continuous application of sub-lethal phosphine dosage may ultimately lead to the total failure of this ideal grain fumigant at a particular site. This inadequate practice increases the cost of pest management and provides basis for selection pressure on the insects, steering towards the development of resistance against phosphine.

For effective pest management with phosphine, a knowledge of the existence of resistance against this particular fumigant and optimum length of exposure is worth. The technique described here will help in the better management of the insect pests. It can be used in the detection of phosphine resistance in insects as well as in the determination of optimal length of phosphine exposure at particular grain storage site. This is a low cost procedure of monitoring the resistance level and has the ability to allocate the fumigation dosage to each location with according need.

Materials Required

i) Plastic drums (about 60 l. capacity) with gastight lids - 20
ii) Glass (cylindrical) jar of about 2 liter capacity ..... - 01
iii) Glass funnel suitable to sink in the glass jar..... - 01
iv) Gas collection tube with one end open and the other end screw capped fitted with a rubber septum ..... - 01
v) Gastight syringes (about 50 ml capacity each) ..... - 02
vi) Clamp with stand ..... - 01
vii) Twenty jars (one kg capacity) for insect holding, AlP tablets, sulphuric acid, aluminum foil, muslin cloth, rubber bands, polyethylene sheet and insects.

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[14] Pakistan Agricultural Research Council (PARC).

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Procedure

Collect sufficient number of insect pests (all species infesting grain) from a grain storage site. Put 1/2 kilogram wheat obtained from the same storage site in each of the twenty glass jars. Put 20-30 insects of each species in each jar. Close the mouth of each jar with a piece of muslin cloth and a rubber band. Place one jar containing insects in each of the plastic drums and close their mouth. The drums being used should be intact and when closed properly with the help of polyethylene sheet, and shouldn't have a leakage rate for phosphine gas of more than four percent per day (Figure 1).

Generate phosphine gas by using FAO's Method No. 16 (FAO Plant Protection Bulletin vol.23; 1975, pp 12-35). This method is slightly modified for use under Pakistani field conditions as detailed below.

Since AlP pellets, recommended in FAO's Method are not readily available in Pakistan, use roughly one fourth portion of the standard 3 gram AlP tablet to produce phosphine gas. The procedure to generate phosphine gas is as under:

1. Pour a 5 % (v/v) aqueous solution of sulphuric acid in the glass jar to fill it up to its half level.

2. Fill the gas collection tube to the brim with the same acidic solution. Close the open end of the gas collection tube with aluminum foil carefully so that when inverted, a least amount of air gets trapped in the tube.

3. Drop the one fourth portion of standard AlP tablet (held in a piece of aluminum foil) into the glass jar. Cover this piece of the tablet by inverting the glass funnel over it as shown in the Fig. 2. Let the funnel along with the tablet settle down in the bottom of the acidic water in the glass jar. Bubbles of phosphine will start emerging from through the neck of the funnel. Take care and keep windows of the room open so that high phosphine concentration does not take place in the air around you.

4. Immediately invert the Gas Collection Tube into the glass jar so that its open end (closed with foil) reaches the neck of the funnel pierce through the aluminum foil into the tube. Clamp up the Gas Collection Tube, held tightly from the other end with the stand to hold it firmly in an upright position in the acidic water.

5. Remove immediately the air and phosphine mixture from the top end of the Gas Collection Tube with the help of a syringe so that acidic water ascends to fill the tube completely and there is no empty space in the tube.

Bubbles arising from the funnel will be that of 86 % pure phosphine gas which will start accumulating in the top capped end of the Gas Collection Tube by pushing the acidic water down. From here, phosphine gas can be retrieved for use in the tests with the help of gastight syringe inserted through the rubber septum.

Using the gastight syringe, introduce phosphine gas @ 0.5 ml per liter capacity of the plastic drum, in each drum containing insects. The gas should be introduced in the drum by piercing with the needle of the syringe through the lid of the drum. Close the hole thus made by sticking a piece of PVC self-adhesive tape over it immediately. There will be roughly 500 ppm of gas in each drum at the start of experiment and after 14 days, the gas will be well above 200 ppm (Figure 1).

Observations

Starting from the third day (72 hours after the introduction of phosphine gas in the drums), open one drum daily and count insect mortality in the jars. Incubate the contents of the jars after removing the live and dead insects for 3-4 weeks to observe the survival of eggs or pupae.

Results Obtained

Results presented in Table 1 show the number of days (exposure period) required to get complete mortality of mixed population of insect pests collected from different grain storage sites of Punjab. The concentration of phosphine gas was retained above 200 ppm throughout the experiment as described in the procedure. Figure 3 shows that the insects collected from the 15 different sites required 4-8 days of exposure period while insects from 9 sites needed 3 days only for 100 % mortality. High resistant insect strains were observed in 6 other grain storage sites. Out of which 4 sites required 9-13 days exposure of phosphine gas while the 2 remaining sites were observed to have the most resistant insect strains needed more than 13 days to get complete mortality. On the basis of exposure period required to get complete mortality, the grain storage sites are divided into four basic groups.

i) 3 days
ii) 4-8 days
iii) 9-13 days
iv) More than 13 days.

A chart can be prepared for the whole country or province on the basis of these groups. By following that chart, a national or provincial strategy for "optimum dosage" of phosphine fumigation can be determined to get a complete control of the resistant insect strains.

The present research technology to determine resistance and optimum dosage to control resistant insects has proven satisfactory. It is simple and easy to adopt. Insect resistance is a continuous process. It changes with the time and environmental conditions to which insects are exposed and needs careful observations. Therefore, it is recommended that a laboratory should be established for this purpose, having equipments for determination of phosphine dosage along with a controlled temperature and humidity room. The laboratory will have close coordination with PASSCO and Provincial Food Departments (PFD's). PASSCO and PFD's will send the insect samples to the laboratory from different storage sites for the analysis of determination of phosphine dosage to achieve complete mortality. The godown in-charge of the storage sites should follow the same dosage of phosphine as determined and instructed by the laboratory. In this

way, the said technology can be utilized as a storage management tool and help to detain the further spread of resistance against this valuable grain fumigant.

GOVERNMENT POLICIES ABOUT WHEAT PROCUREMENT, STORAGE, AND RELEASES

Muhammad Sharif[15]

Faithful implementation of support price policies of the government in respect of different crops has played a significant role in development of such crops in the country. Adequate production of wheat, being a staple food of the country has been the main target for government. On the other hand, it has also to be ensured that wheat products are made available to the consumers at cheaper rate. This sensitive assignment has been entrusted to the Food Department. In order to carry out this assignment, the Food Department has to perform the following functions.

Procurement of Wheat at Support Price.

Punjab has been playing a major role in procurement of wheat in the country. From Punjab, wheat is not only purchased for consumption within the province, but also for supply to other provinces. Generally, the Food Department has been pruchasing wheat for local consumption whereas PASSCO has been purchasing wheat for supply to other provinces. Table 1 shows quantum of wheat procurement by the Food Department and PASSCO during the last 5 years. It should be noted that about one-third of the crop size is purchased by the Food Department and PASSCO.

Mechnical threshing of the wheat crop has made its procurement a big task as most of the market surplus is brought to the markets and wheat procurement centers set up by government agencies immediatly after harvest. Table 2 shows arrival of wheat at the procurement centers during different months of the last 5 years. It would be observed that most of the wheat is purchased during the month of May.

Handling of Wheat and Storage

Handling of such a large quantity in such a short time is not an easy job. In the past, most of the quantity used to be handled manually but now, it is felt that it would not be possible to depend entirely on manual handling in the future, not only due to quantum of work to be performed in a short time but also because of increasing wages due to speedy growth of industries resulting from the deregulation policy of the present regime. It has, therefore, been decided to introduce mechanical handling in a phased program. The Food Department had only one facility for bulk storage at Faisalabad with a capacity of 4,000 Mt. In the early 1970s, steel silo storage capacity of 42,000 Mt at Multan, with mechanical handling equipment, was purchased by the Food Department. Bulkheads having storage capacity of 6,000 Mt were constructed with the assistance of the World Bank during 1989-90.

Hexagonal bins of 10,000 Mt capacity have been provided mechanical handling equipment at Okara and Sahiwal last year, with the help of USAID. In this way, the Food Department is heading towards bulk handling of wheat which would not

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only ensure speedy grain handling, but would also reduce incidental charges by eliminating jute bags, which is about 38% of the total incidental charges.

The Food Department has over 2,373,000 Mt of storage capacity. As it was not possible to construct godowns in the public sector due to financial constraints, a policy of construction of godowns in the private sector was introduced. Interested parties under this scheme had to enter into an agreement with the government to provide godowns on a rent of Rs 1.5 per square foot for 10 years. On the basis of this agreement ADBP has to provide loans. This scheme received much response from private parties and godowns having storage capacities of 91,800 Mt are under construction. This scheme got so popular that the government had to sop making such agreement through the provice except for Rawalpindi and D.G. Khan divisions.

Sale of Wheat

As earlier stated that government has to ensure a regular supply of flour and other wheat products at cheaper rates throughout the year. In the present marketing setup, wheat remains available in substantial quantities only up to the months of August/September. From Octover onwards, flour mills have to depend mainly on supplies from the government. Sales of wheat from government godowns during the last 5 years are presented in Table 3.

During the last year, we had abundant stocks of wheat and we had released government stocks liberally, but during the current year there was less procurement and as such we had to restrict our releases. Despite increase in milling capacity, we would restrict our releases to about 24 lac tons up to April, 1992.

In order to supply wheat products at cheaper rates to the consumers, government is selling wheat at subsidized prices. Table 4 shows the cost price, sale price, and componant of subsidy borne by the government.

Maintenance of Government Reserves

In addition to regular supplies of wheat throught the year, the Food Department has also to maintain strategic reserves of wheat at least five lac tons to meet any emergency situation in the country. Table 5 shows Food Department reserves on April 30, i.e., at the time of arrival of new crop, during the last 5 years.

TABLE 1

WHEAT PROCUREMENT BY GOVERNMENT AGENCIES
AS A PERCENTAGE OF TOTAL PRODUCTION OF THE PUNJAB PROVINCE

Scheme Year	Size of Crop (1000 Mt)	Procurement Price (Rs/100 Kg)	Wheat Procurement		Total	Procurement as % of Production
			Food Dept	PASSCO		
1987-88	8,334	200.00	1,599	1,341	2,940	35.28
1988-89	9,204	206.25	1,717	1,054	2,881	30.10
1989-90	10,517	212.50	2,146	1,251	3,397	32.30
1990-91	10,518	240.00	2,534	1,143	3,677	34.96
1991-92	10,514	280.00	1,458	1,125	2,583	24.57

TABLE 2

EFFECT OF MECHANIZED THRESHING OF WHEAT ON PACE OF PROCUREMENT

Month	1987-88		1988-89		1989-90		1990-91		1991-92	
	Quantity Purchased	Percentage of Total Procurement	Quantity Purchased	Percentage of Total Procurement	Quantity Purchased	Percentage of Total Procurement	Quantity Purchased	Percentage of Total Procurment	Quantity Purchased	Percentage of Total Procurement
	(1,000 MT)		(1,000 MT)		(1,000 MT)		(1,000 MT)		(1,000 MT)	
April	32.40	2.00	11.40	1.00	10.00	0.50	8.00	0.50	-	-
May	884.00	55.00	1,356.70	80.00	1,492.00	70.00	1,763.00	69.00	1,056.00	72.45
June	614.30	39.00	313.00	18.00	604.00	28.00	735.00	29.00	380.00	26.00
July	67.10	4.00	25.80	1.00	38.00	1.50	27.00	1.50	22.00	1.55
Total	1,598.60	100.00	1,716.90	100.00	2,144.00	100.00	2,533.00	100.00	1,458.00	100.00

TABLE 3

YEARLY SALES OF WHEAT BY PUNJAB FOOD DEPARTMENT

May -- April	1000 Mt
1987-88	2,359.70
1988-89	2,551.10
1989-90	1,905.80
1990-91	2,469.00
1991-92	1,448.26*

* As of January 31, 1992.

TABLE 4

COMPARISON OF COST INCURRED BY FOOD DEPARTMENT
ON ITS DIRECT PURCHASES FROM PASSCO AND
ON IMPORTED WHEAT DURING 1991-92

		Direct Purchases from Owner by Food Department (Rs/Mt)	Purchases Through PASSCO (Rs/Mt)	Imported (Rs/Mt)
Purchase Price	-	2,800.00	3,453.62	3,100.00
Incidental Charges	-	725.31	488.95	982.63
Cost Price	-	3,525.31	3,942.57	4,082.63
Sale Price	-	3,250.00	3,250.00	3,250.00
Net Loss	-	275.31	692.57	832.63
Extra Loss per Ton on Purchases of Wheat Through PASSCO and Imports			417.26	557.32
Quantity Purchased Through PASSCO and Imports			333,745 Mt	435,000 Mt
Total Extra Loss on the Purchase of Wheat Through PASSCO and Imports			Rs 138,006,658	Rs 242, 434,200

TABLE 5

WHEAT RESERVES AT THE END OF WHEAT PROCUREMENT YEAR
(April 30)

(1000 Mt)

Year	Reserve
1987	1,876.00
1988	919.00
1989	167.00
1990	961.00
1991	771.00*

*771.00 + 63.00 (PASSCO) = 834.00

GRAIN MARKETING SYSTEM AND FUTURE STRATEGIES IN PAKISTAN

Qammar Mohy-ud-din[16]

Food grains are of vital importance where average caloric intake is near or below that considered necessary for normal human energy. The functions performed in the grain marketing system depend on the stage of development of the agricultural economy. As the economy develops and urban demand increases, a market mechanism needs to be developed to handle the increased quantities being transferred from the producers to urban consumers.

Pakistan has considerably improved its agricultural marketing system through the adoption of various measures. The marketing structure thus evolved comprises areas in which private enterprise is free to operate, as well as those entirely under government control. Between these two extremes, other arrangements exist involving varying degrees of government participation in the form of fixaton of support/procurement prices, procurement and export quotas, and so on. Historically, the marketing system of food grains in Pakistan has suffered from the following constraints.

1. Small marketable surpluses in the subsistence holding which comprise about 70% of the total number of holding scattered throught the country.

2. Poor economic condition of the farmer, forcing him to sell his produced immediately after harvest.

3. Lack of proper grading by the producers due to inadequate know-how, facilities, and quality-consciousness.

4. Inadequate means of transportation.

5. Non-availability of good marketing intelligence services.

6. Lack of proper physical facilities.

A number of steps have been taken by the government, with varying degrees of success to reduce the aforementioned constraints. A detailed description of the marketing system along with the specific constraints of important food grains is discussed below.

Marketing System

Wheat. About 53% of the marketed surplus is sold in the villages, 11% at procurement centers, and 16% in the market/Mandis. The reasons for not taking produce to the procurement centers include high kind deduction, overweighment, difficulty in getting gunny bags, and delayed payment of sale proceeds. The main

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reasons for selling the produce in the villages are reasonable price, lack of transportation, and malpractices at the procurement centers/market.

Sales made direct by the producer/seller to the procurement centers increase with decrease in distance. Those who are close to the procurement centers (within one mile) sell about 40% of their produce direct to the procurement centers as compared to 23% who sell at the distant procurement centers (beyond 5 miles radius).

Of the total purchases made by procurement centers, only 34% come directly from the grower/seller, while the remaining come from village dealers and commission agents. About 87% of the total lots purchased by the procurement centers are in big lots (over 200 maunds each).

Those procurement centers where a supervisory committee has been constituted and are also visited more frequently by the higher officers, attract maximum sales direct by the producer/seller and encourage prompt payment of sale proceeds.

Rice. The marketable surplus is about 80% of the total production of fine and 85% of the course rice. About 50% of the growers sell their paddy in the village to village dealers. The reasons for selling in the village are low marketable surplus, hign kind deduction in the market, and delay in the payment of sale proceeds. Almost 30% of the growers sell their produce to the commission agent and 20% to the processor/procurement center. The marketing margins of the intermediaries are on average 35% for fine and 40% for consumer price for course rice.

The farmers face problems like high kind deduction, overweightment and delayed payment of their sale proceeds at purchase centers or at commission agent/processor level. No premium is paid for good quality produce. Establishment of adequate number of purchase centers and the effective supervision of these centers through inspection teams can improve the working of these centers. Provision of modern dryers with the processing plants will reduce the losses. Institutional loans given to the growers, commission agents, and processors will solve their financial problems.

Maize. About 35% of the growers sold their produce to the village dealer and the remaining 65% through commission agents in the markets.

About 15% of the registered growers of Rafhan Maize Products Ltd. graded their produce and got a reward of Rs 3 per maund. The reasons for future contract with Rafhan were the provision of seed and other inputs on credit and technical know-how to the grower.

The commercial organizations like Rafhan, Glaxo, and Poultry Feed Mills purchase maize from the open market through the broker. The feed mills purchase about 30 to 35% of the total arrivals of maize in the market. They generally purchase B-grade maize having more moisture content.

Daily crushing capacity of different industrial units in Pakistan has reached 465 Mt, and is expected to increase very fast in the future. The consumption of maize starch and liquid glucose by local industry is 39,000 and 9,200 Mt per year

with 6% growth rate per year. Rafhan Maize Products has been playing a very important role in the marketing of maize for many years. The firm's share of total dealings in maize in the country is more than 40%. The firm fulfills its 45% of demand of maize from its registered growers and 55% from the open market through commission agents/brokers. The share of total maise purchased from Punjab and NWFP is 73 and 27%, respectively. Messer Glaxo, Lahore, purchases 83% from NWFP and 17% of maize from Punjab.

The wholesalers also purchase maize from the market and village dealer in the peak harvest months and sell to the seed retailers and commission agents when the price of maize goes high. The retailers process the maize, purchased from the open market through power "chakkies" and sell flour to the consumer.

Price settlement under cover, illegal deductions, speculation of commission agents and wholesalers at the cost of growers, lack of price information with the growers, and biased sampling of the produce of registered growers of "Rafhan" are the main problems faced by the farmers. The market committees and the authorities of Rafhan should give due consideration to the complaints of the growers.

Pulses. Mung, mash, masoor, and gram are the important pulses grown in the country. The province of Punjab accounts for 71% of the total area under pulses in our country. The marketable surplus of pulses is about 80% of the total production. About 90% of the producers sell their produce to the village dealer due to small marketable surplus, transportation problems, and avoiding botheration of selling at market. About 80% of the produce is sold immediately after harvest due to pressing financial needs. The village dealers generally sell the produce to commission agents and at the PASSCO purchase centers. The commission agents supply the pulses to the processors for splitting. Retailers purchase the splitted produce from the processor for sale to consumers. High marketing margins of the market intermediaries, particularly the retailers, can be reduced by creating more competition through utility stores/fair price shops. PASSCO should try to reduce its marketing cost and should process the produce through the private processors.

Future Strategies

As regards the future strategies comprehensive research studies should be planned on the following topics:

1. Economic evaluation of government policies about the pricing and procurement of food grains.

2. Economic analysis of international trade in rice.

3. Study of grain storage management.

4. Study of the effect of food grain prices fixed by the government on resource allocation,

5. Study the role of market committees in the management of the grain markets.

6. Use of modern technology in handling, storage, transportation, drying, processing, packing, and grading of food grains.

The recommendation of these studies will help the planners and policy-makers to formulate the policies for improving marketing of food grains in the future.

A LOOK ON MYCOTOXIN PROBLEMS OF STORED GRAINS IN PAKISTAN

J.H. Mirza and M.A. Nasir[17]

Considerable postharvest losses are incurred in stored grains. Although no exact figures are available, no agreement is found as to their extent (Chaudhry, 1980). F.A.O. estimates of world losses are placed at 5%. These vary from country to country and from year to year. For the subcontinent, according to Christensen and Kaufman (1969) 30% of the annual harvest is lost due to rodents, insects, mites and fungi. According to Chaudhry (1980) the storage losses in public sector in Pakistan could not be estimated correctly by response method due to misreporting of storage agencies. However, he estimated the losses at 5.08, 3.83, and 3.05% for wheat, rice, and corn, respectively by sampling method.

Grains harbor a variety of fungi. These get associated with the grain either during its development in the field (field fungi) or grow only after they are stored (storage fungi). Common examples of field fungi are species of Alternaria, Fusarium, and Drechslera, while those of storage fungi are species of Aspergillus, Penicillium, and Rhizopus.

Association of these fungi with the grain produces certain deleterious effects on the grain. The major types of harmful effects produced by fungi are: decrease in germinability, total or partial discoloration of kernel, heating or mustiness of grain, harmful biochemical changes, production of mycotoxins, and loss in weight,

Considerable amount of research has been done on various aspects of these losses. In all cases of spoilage of grains one or more of these deleterious changes may occur depending upon extent of spoilage. Any or all of these changes including the production of toxins may occur with or without the responsible fungi being visible. Grains in the final stage of decay by the storage fungi may be caked or bound together by the fungus mycelium and may have a storage musty odor.

Although duration of storage temperature, grain damage aeration, amount of foreign material, invasion by insects and mites also affect the development of storage fungi, by farm the most important single factor is the moisture content of the grain (Ahmad and Nasir, 1984; Mohammad, et. al., 1985).

Table 1 shows the critical moisture content level for the development of various micro-organisms in cereal grains. Table 1 shows that moisture requirement of field fungi is more than that of storage fungi.

A number or researchers have determined the critical moisture content for safe storage of various grains. These are given in Table 2.

Storage fungi do not grow at moisture contents below these critical points. However, the safe moisture content and oil contents are closely related.

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Moisture not only affects the growth of fungi in grains by also the mycotoxin production by them.

Mycotoxins have been affecting human affairs for a long time. Man has been familiar with mushroom poisoning since antiquity. There ave been reports of Ergotism, a kind of mycotoxicosis involving man and animals since middle ages, and in central parts of Illinois in 1933-34, due to eating of moldy corn. However, the best known case is one in which 100,000 turkey poults died in England in 1960 of a mysterious disease of unknown aetiology due to consumption of moldy feed traced to a lot of peanuts from Brazil. This resulted not only in the discovery of aflatoxins, but also triggered an interest in research on mycotoxins. It also resulted in the isolation and identification of a wide variety of mycotoxins from the field as well as storage fungi causing diseases in man and animals. The modern awakening of scientists to an awareness of mycotoxins and their insidious effects began only since 1960.

A considerable amount of research has been done on grain mycoflora in Pakistan, but most of this work concerned itself with seed germination and protection of embryo and resulting seedlings from see-borne diseases. We at the University of Agriculture initiated research on stored-grain fungi in collaboration with NIAB in 1970 (Mohyuddin, et. al., 1971). This work was later on continued at NIAB in the form of a PL480 research project by Amin Hussain and M. A. Nasir and their associates which culminated in a final research report in 1981 entitled "Fungal Spoilage of Stored Wheat, Rice, Maize and Sorghum Grains and Their Products."

There have been constant press reports of food poisoning in human beings and or mycotoxicosis in animals in Pakistan without any authentic published proof in most of these cases. Probably they involve mycotoxins of various groups. However, all the research on the production of mycotoxins in Pakistan is restricted to aflatoxins (Iqbal, et. al., 1976; Chaudhry, et. al., 1981; Bhatti, 1982; sultan, et. al., 1983; Hamid and Shah, 1984).

A number of workers have isolated a variety of fungi (both field and storage) from stored grains (especially wheat, rice, corn, and sorghum) and their feeds. Iqbal, et. al., (1976) found 11 species of Aspergillus and 5 species of Penicillium associated with stored grains producing one or more types of aflatoxins. Hamid and Shah (1984) isolated a total of 16 isolates of A. flavus from peanuts but only 6 of them were toxigenic. Nizami and Zuberi (1977) found food samples including rice, grain, peanut, and corn to be contaminated with aflatoxins. They concluded that a long term ingestion of even low doses of aflatoxins with food may be responsible for liver cancer. Zuberi, et. al., (1976) reported an incidence of liver cancer of 3-6% in Karachi which then considered to be possibly due to aflatoxins and once produced in any material, are never detoxified.

In Pakistan, due to favorable climatic conditions for mycotoxin production and poor storage arrangements, the chances of contamination of stored grains with other food and feed stuffs with mycotoxins are greater. Such risks could be brought down if the food grains are stored with less than 13% moisture content under improved storage conditions with proper air circulation, ventilation, and moisture proofing.

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TABLE 1

CRITICAL MOISTURE CONTENT LEVEL FOR THE DEVELOPMENT OF VARIOUS MICRO-ORGANISMS IN CEREAL GRAINS

% Moisture Content	Micro-organism
	Storage Fungi
10.0 - 17.0	*Aspergillus glaucus* group, *A. candidus*, *A. ochraceus*, *A. restrictus*
15.6 - 21.0	*Penicillium* spp.
18.0 - 20.0	*Aspergillus flavus*, Bacteria
	Field Fungi
18.4	*Fusarium moniliforme*
22.2	*F. graminearum*
21.2 - 33.0	*Alternaria* sp., *Cephalosporium acreemonium* *Diplodia zeae*, *Fusarium* spp., *Helminthosporium* sp., *Nigrospora sphaerica*

TABLE 2

CRITICAL MOISTURE CONTENT FOR SAFE STORAGE OF VARIOUS GRAINS

Grain	Moisture Content	Reference	
Sorghum	14.5%	Christensen	1970
Wheat and Corn	12.5 - 13.5%	Christensen	1970
Groundnut (Peanut)	8.5%	McDonall	1968

TABLE 3

FUNGI PRODUCING SOME IMPORTANT MYCOTOXINS

Toxin	Fungi
Allergenic Toxin (s)	*Alternaria tenuis, Aspergillus flavus, Gandida albicans, Cladosporium sp., Fusarium equiseti, Helminthosporium sp., Mucor sp., Penicillium citrinum, Puccinia sp., Ustilago sp., Verticillium sp.*
Aflatoxin	*Aspergillus flavus, A. niger, A. ostianus, A. parasiticus, A. ruber, A. wentii, Penicillium citrinum, P. frequentans, P. puberulum, P. variabile*
Diacetoscirpenol (T2 Toxin)	*Fusarium equiseti, F. nivale, F. solani, F. tricinctum*
Emetic Toxin	*Fusarium culmorum, F. graminearum, F. moniliforme, F. nivale, F. poae*
Ergotamine	*Claviceps purpurea*
Haemorrhagic Toxin	*Alternaria tenuis, Aspergillus chevalieri, A. clavatus, Cladosporium epiphyllum, C. fagi*
Kojic Acid	*Aspergillus flavus, A. parasiticus, Aspergillus spp.*
Ochratoxin	*Aspergillus alliaceus, A. melleus, A. ochraceus, A. ostianus, A. sclerotiorum, A. sulphureus, Penicillium viridicatum*
Polyuric Toxin	*Rhizopus stolonifer*
Rubratoxin	*Penicillium purpurogenum, P. rubrum*
Stachybotrytoxin	*Stachybotrys alternans*
Sterigmatocystin	*Aspergillus flavus, A. nidulans, A. rugulosus, A. versicolor, Bipolaris sorokinianum, Penicillium luteum*
Zearalenone (F2 Toxin)	*Fusarium graminearum (Gibberella zeae), F. culmorum, F. equiseti, F. moniliforme, F. tricinctum (Nectria radicicola)*

Source: TPI, G105 (1976)

TABLE 4

FUNGAL STRAINS PRODUCING TOXIC METABOLITES

Fungus	Strains Tested	Proven Toxic
Botryodiplodia	21	9
Cladosporium	22	9
Curvularia	3	1
Fusarium	117	61
Gliocladium	5	3
Macrophoma sorghicola	5	2
Nigrospora oryzae	17	8
Paecilomyces varioti	5	2
Penicillium sp.	246	73
Aspervillus flavus	25	18
Other *Aspergilli*	208	79
Rhizopus sp.	55	18
Scopulariopsis brevicaulis	3	1
Trichoderma viridi	15	4
Trichothecium sp.	8	3

Source: TPI, G105 (1976)

TABLE 5

AFLATOXIN PRODUCTION BY SOME FUNGI ASSOCIATED WITH STORED GRAINS

Seedborne Fungi	Aflatoxin Produced B1	B2	G1	G2
Aspergillus candidus	+	+	+	+
A. nidulans	+	+	+	+
A. wentii	+	+	+	+
A. niger	+	+	+	+
A. parasiticus	+	+	+	+
A. ochraceus	+	-	+	+
A. sulphureus	+	-	+	-
A. sydowi	+	-	+	-
A. versicolor	+	-	+	-
A. fumigatus	+	+	-	-
A. oryzae	-	-	+	-
Penicillium notatum	+	-	+	-
P. purpurogenum	+	-	+	-
P. variabile	+	-	+	-
Penicillium sp.	-	+	+	+
P. oxalicum	-	-	-	-

+ = presence of aflatoxin, - = absence of aflatoxin

Source: Iqbal, et. al. (1976)

RECOMMENDATIONS OF SEMINAR/WORKSHOP[18]

Those in attendance at the above named workshop have deliberated the issues presented and reached a consensus on the following.

Be it resolved that:

Resolution 1

Grain Storage Management be recognized as a profession requiring knowledge and training.

a. There should be a publicity program to create nationwide awareness of the importance of proper storage in protection of health and welfare of citizens.

b. Due recognition must be given to proper storage of materials for both human consumption and production of animal feeds.

c. Changing attitudes of public officials and private sector management toward proper storage is first step in improving the present system.

Resolution 2

Storage can only protect and maintain the quality of wheat stored, it cannot improve upon what has been produced.

a. There is a need for development and strict application of grades and standards for grains and grain products applicable to Pakistan conditions.

b. A first step should be the proper enforcement of present FAQ standards.

c. Research should be initiated on development of more suitable standards to meet the needs of consumers and industry.

d. The feasibility of using differentiated prices for procurement and release of wheat should be further studied. The experimental releases of cleaned wheat by the Punjab Food Department should be continued in different areas to test the practicality of the pricing system.

Resolution 3

The volume of wheat production is increasing and time of harvest is decreasing due to introduction of modern machinery and need to plant second crops. The present storage system using bags is not able to meet the demands placed upon it. Conversion of grain storage to some of form mechanized handling is inevitable.

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[18] Presented by M. Akhtar, University of Fiasalabad.

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a. Any present modification and future design of storage should be able to incorporate bulk system when and where feasible. Steps should be taken to develop minimum design standards for bulk systems for the guidance of the public and private sectors.

b. Research be encouraged and conducted on the long term strategies for grain storage, including:

   1) Specifications for storage structures

   2) Type and location of procurement centers, storage reservoirs, and the national food reserves.

   3) Role of private sector in procurement and storage

   4) Social and economic impact of shifting to bulk handling.

Resolution 4

The profession of grain storage requires a constant input of knowledge, training, and support from many academic disciplines. The University of Agriculture, Faisalabad can provide leadership and generate the knowledge required for the improvement of grain storage in Pakistan.

The University of Agriculture, Faisalabad:

a. Shall become the national center for grain post harvest research and training, center of training for personnel for grain storage industry, including short term academic training for public and private sector.

b. Create an atmosphere in which grain storage issues can be fully explored and creative solutions can emerge from cooperative efforts with public and private sector.

c. Establish a grain milling school in cooperation with flour milling association. Such a school should be designed to address needs of Pakistan milling industry, and be supported by public and private sectors.

SELECTED REMARKS ON
SEMINAR/WORKSHOP ON GRAIN STORAGE MANAGEMENT RESEARCH
AND TRAINING CONFERENCE RECOMMENDATIONS

Khalid Saeed[19]

Taken From Recording

Commentary on Workshop Resolution and Recommendation

Resolution 2

At the moment there are no restrictions on the private sector in the purchase and storage of wheat, and many of them do. However, due to the heavy expenditure on the purchase and storage of wheat, most of them find it impossible to purchase and store for at the most one month's requirements. So they have to rely on government purchases of wheat for their supplies.

But what we are trying to do is we are looking at the possibility of letting out some of our godowns to the private sector. We are also looking at providing credit by going to the banks and asking them to provide loans to these people and they will find it much easier to enhance their scope of operations. Ultimately, the losses we are having to incur in the public sector will be taken care of by the private sector itself.

Resolution 3

Now regarding the issue of socio-economic impact of shifting to bulk handling, this is one thing that has been keeping us away from adopting bulk handling. Now that we are experimenting with bulk handling in a gradual way, we will be able to take care of that institutional linkages.

As I said in my earlier remarks, there is an urgent need for some kind of institutional linkages between the University and the Food Department. I very much appreciate the organization of this seminar as a step in that direction. The institution of this diploma course will go a long way in helping us achieve that objective.

Similarly, the idea of establishing a grain milling institute is a new idea although I am told that such milling institutes are already working in some other countries.

In this context, some representatives of the milling industry are here today and taking part in this seminar. As I give thought to the need for this milling school, it occurs to me that whatever we do with grading at the time of purchase, or talk of FAQ and need for improvement of wheat quality, that ultimately, as far as the consumer is concerned, the end product is wheat flour. The quality for that wheat flour ultimately depends upon the milling. Even if there was some

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laxity or weakness in wheat purchases at the time of procurement, that can be taken care of in the milling process. It is the flour miller who has to face the consumer. The miller must meet the specifications laid down in the Food Laws.

In most cases, if there is any differences between what is required, it is the subordinate staff who is responsible for supervising the entire operation. And they are the people who may have no idea at all as to what will go wrong if they do not follow the particular instructions.

I think this milling school will definitely be very beneficial to the milling industry in Pakistan. There they can find a forum where they can send their staff, where their staff will be told what is the best way to operate, and how to maintain the prescribed specifications. Once this is done, the problems which some of our millers face can be resolved. Once the samples of the product is taken which does not conform, sometimes the acidity or moisture content is not correct, sometimes there is more ash content, can be corrected. As I said earlier, some of these problems are due to the ignorance or lack of training of staff in the private sector.

So I do hope that this milling school will be the answer to their problems. I am also happy to learn that the milling industry has indicated a willingness to share the expenses involved in running the school.

I think this is all that I have to say on these issues. Once again I would like to thank the organizers of this seminar for inviting me over here and conducting this seminar.