GOOD PRACTICES FOR ANIMAL FEED AND LIVESTOCK 2

training manual

MAINTAINING QUALITY OF FOOD AND FEED GRAIN THROUGH TRADE AND PROCESSING

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Preface

The grain produced by the farmer has a long journey to travel on its way to the consumer's plate or the animal's feed trough; it may be processed into value-added foods or feeds for consumption in urban or other areas that are remote from the site of production. There may be a long chain through which the crop will be transported, stored and processed, with accompanying losses in quality, quantity, nutrient content and monetary value at each stage. If these losses are allowed to occur and build up, there will be a significant loss in revenue for the producer and the end user. Therefore, no matter how many stages there are in the marketing chain, it is important that grain quality is maintained throughout the chain so that the end product fetches the best price possible, retains a high nutritive value, and appears attractive to buyers.

This booklet describes the causes of these potential problems and illustrates actions that should be undertaken to prevent or remedy them. Many of the solutions do not require technical methods or equipment, but do rely on attention to detail, perseverance and common sense. The booklet does not address problems that can, and do, occur on the farm; a separate booklet addresses on-farm situations. This account assumes that grain and grain products, including flour and animal feed, have reached the first point in the marketing chain after leaving the farm. The first point may be a small-scale trader who is buying directly from the farmer, or a middle-man. The situation of transit storage and long-term storage, such as would occur in hospitals, prisons and boarding schools is considered. Millers and feed compounders are also included. However, large-scale storage such as by marketing boards and private exporters who use silos and warehouses holding many thousands of tonnes of grain in central storage complexes is not included; large scale operations require addressing in a very specific manner not appropriate to smaller-scale organisations.

One of the problems in dealing with issues at this level of the marketing chain is that no one specific group or organisation has responsibility for providing advice to traders and millers. The booklet is not intended to be used solely by the ultimate beneficiaries themselves, though it may well be. It is intended to be used by anyone who is involved in providing practical advice to counteract the causes of deterioration of grain and grain products along the marketing chain. These may be pest control suppliers, retailers and wholesalers, extension personnel within and outside of government, staff of trading organisations including marketing boards, and trade unions.

Acknowledgements

I would like to thank the Natural Resources Institute UK for allowing me to reproduce photographs from its collection. The information is largely in the public domain. I have in particular referred to two text books for background material: 'Crop Post-Harvest Science and Technology. Volume 1: Principles and Practice' edited by Golob, P., Farrell, G and Orchard, J.E (2002), published by Blackwell Science, and World Food Programme Food Storage Manal (2003) ed. Walker, D. and Farrel, G.

Causes of deterioration

Grain at the time of harvest may be damaged by field infestations of insect, bird and rodents pests; fungal, viral and bacterial infection; or the ravages of flooding, high winds or drought. In essence, it is impossible to ensure that any harvested crop will be perfect. However, farmers should always strive to obtain the best crop they can, because this will ensure the best possible return on their investments and efforts. This grain will then be used to feed the family or, as is increasingly the case, sold for processing into value-added foods or feeds for consumption in urban or other areas that are remote from the site of production. There may be a long chain through which the crop will be transported, stored and processed before it reaches the consumer's plate or in the animal's feed trough, with accompanying losses in quality, quantity, nutrient content and monetary value at each stage. If these losses are allowed to occur and build up, there will be a significant loss in revenue for the producer and the end user. Therefore, no matter how many stages there are in the marketing chain, it is important that grain quality is maintained throughout the chain so that the end product fetches the best price possible, retains a high nutritive value, and appears attractive to buyers. This booklet describes processes by which grain quality and quantity can be maintained throughout this marketing chain.

The main causes of deterioration of grain and grain products are:

- *Physical factors*: wetting, heating, breakage, discoloration, contamination with foreign matter such as stones, rodent droppings, string;
- *Biological factors:* mould, insects, rodents, birds, goats;
- *Human factors:* theft, poor handling.

Physical factors affect food commodities particularly during transportation, although heat and moisture can also influence deterioration during storage. Biological factors predominate during storage and human factors occur throughout the marketing chain.

Losses can be substantial and result in a significant mark down in value. The commodity may be downgraded, deemed unfit for export, and thereby result in a significant loss of foreign exchange earnings. There may be a physical loss of weight, loss of seed viability, and a decrease in nutritive value - an important issue in much of the developing world where a large proportion of the population is undernourished.

LOSS OF QUALITY

Quality is difficult to define and to measure objectively, except in terms of monetary value. Traders and consumers purchasing or selling in the market place usually define quality in

TABLE 1 GRADE DEFINITIONS FOR MAIZE IN INDIA

Grade no.	Maximum limit of tolerance (%)					
	Foreign matter	Other food grains	Other varieties	Damaged grain	Immature grain	Weeviled grain
I	1.5	1.0	10.0	1.0	2.0	1.0
II	2.5	2.0	15.0	2.0	4.0	3.0
III	4.0	4.0	20.0	3.0	6.0	5.0
IV	4.0	5.0	20.0	5.0	6.0	10.0

Note: The moisture content must not exceed 12%. The grain must have uniform shape and colour.

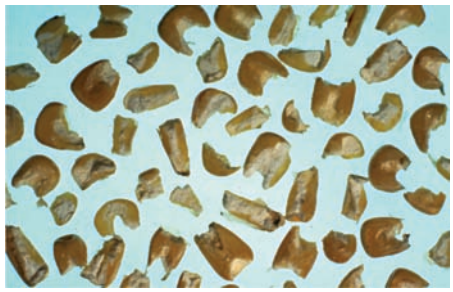
subjective terms. However, objective parameters may be established by governments introducing grading methods or by similar rules developed by autonomous trading organisations such as marketing boards, milling companies and grain exporters. Grain quality is usually assessed and grades assigned on the basis of appearance, shape, size and colour, although smell and uniformity will also be relevant. An example of the Indian standard for maize is shown in Table 1. Small scale traders and consumers will often assess on the basis of *fair average quality* (FAQ), which requires no quantitative measure of parameters but is a subjective assessment of whether the commodity meets a level which is generally acceptable to all.

Foreign matter content and contaminants are also factors that affect quality. These may include rodent droppings and hair, insect fragments and frass, weed seeds, parts of plants, soil, stones, glass and string. Contaminants that cannot be readily removed include urine, oils, pesticides, bacteria and viruses spread by rodents and mycotoxins. The higher the standard set by the consumer the greater will be the potential for loss; for example, produce to be sold in urban supermarkets will need to achieve a higher standard than the same produce sold at a local rural market.

LOSS OF QUANTITY

At primary selling points such as rural markets, grain is frequently sold by volume. This can cause problems when the unit of sale is not standardised. For example, in Southern Africa it is possible to fill a large jute sack with between 90 and 120 kg of grain depending on the sack's age, as older ones can be stretched more easily than new ones, and therefore have greater capacity . Furthermore, very dry grain will have a tendency to shrink and so occupy less volume for a given weight. It is also not unknown for sellers to add stones, dust and other extraneous matter to a sack to make up the volume.

FIGURE 1 **Rodent damaged maize**



Note: rodents feed on the germ and remove much of the protein and vitamins

Further along the marketing chain trading is carried out on the basis of weight. Then it is relatively easy to detect losses but these may not necessarily be due to a loss in food value. The loss may be due to a reduction in water content, which occurs during storage under conditions of low relative humidity; water is given up by relatively wet grain to the drier air.

Loss of food value is caused by pest damage, insects, rodents and birds feeding on grain, or by mould, yeast and bacterial infections. Pest attack will result in either whole grains being removed, as is frequently the case when rodents are prevalent, or parts of the grain being eaten *in situ*, commonly the result of insect infestations. Infections by fungi and bacteria frequently make the grain unappealing and should result in grain being discarded but, in practice, mouldy grain is often reserved for livestock or for brewing. It is however dangerous for mouldy grain to be used in this manner as often it contains mycotoxins that can have severe deleterious effects on the health of livestock.

NUTRITIONAL LOSS

Weight loss is a reflection of the overall food loss. Nutrient loss may be proportionately larger because of selective feeding by pests. Rodents and some insect moth larvae, e.g. *Ephestia* and *Plodia,* feed preferentially on the germ of the

grain, removing a large percentage of the protein and vitamin content. Weevils feed mainly on the endosperm and reduce the carbohydrate content. Many pests eat the bran of cereals, thereby reducing the vitamin content; book lice, *Liposcelis* spp., feed selectively on the germ and bran. High moisture content and the associated growth of micro-organisms also lead to changes in vitamin content of grain. Bruchids, such as the cowpea weevil, *Callosobruchus maculatus,* feed on the cotyledons of pulses and the loss of protein due to such infestation is serious, as up to 25% of the dry bean matter may be crude protein.

LOSS OF SEED VIABILITY

A reduction in seed germination may be caused by changes in temperature, moisture content, excessive respiration by kernels, light, insect infestation and by some methods of insect control. Attempts to control insects by subjecting grain to heat, either in a commercial dryer or over the kitchen fire in a farm may well affect the germination capability. This will not matter if the grain is designated for food or feed but will if some of it is earmarked for seed. Insects and rodents that selectively attack the germ will cause a greater loss of germination potential.

COMMERCIAL LOSS

This may occur as a direct consequence of the above, or indirectly as the cost of remedial measures required, for example the fumigation of insect damaged grain. Downgrading may be required and this will reduce the price to the seller; grain may be then designated for animal feed rather than for human food. Commercial losses may be expressed in terms of monetary loss, a loss of goodwill, and loss due to legal action. Commercial losses may affect inter-country trade: for example, after an outbreak of the destructive maize pest *Prostephanus truncatus* in Tanzania, Malawi and Somalia refused to accept Tanzanian maize because of the risk of the insect spreading to their countries.

These losses occur throughout the marketing chain. The following sections examine how and why they occur, and identify methods by which they can be reduced and quality and value maintained.