

# **AT** MICROFICHE REFERENCE LIBRARY

A project of Volunteers in Asia

Storage of Foodgrain: A Guide for Extension  
Workers

by: Abdel-Hamid F. Abdel-Aziz

Published by:

Food and Agriculture Organization of the  
United Nations  
Via delle Terme di Caracalla  
00100 Rome  
Italy

Paper copies are \$ 6.00.

Available from:

UNIPUB  
P.O. Box 433  
Murray Hill Station  
New York, NY 10157 USA

Reproduced by permission of the Food and  
Agriculture Organization of the United Nations.

Reproduction of this microfiche document in any  
form is subject to the same restrictions as those  
of the original document.

# storage of foodgrain

a guide for extension workers

food and agriculture organization of the united nations

**STORAGE OF FOODGRAIN**  
**A Guide for Extension Workers**

by

**Abdel-Hamid F. Abdel-Azis**

**formerly FAO Project Manager**  
**Farm and Community Grain Storage Project, India**

**FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS**

**Rome, 1975**

The author wishes to acknowledge the valuable cooperation of  
G.G. Corbett and H.R. Shuyler of the Agriculture  
Department of FAO in the preparation of this manual

Issued by the Agricultural Education and Extension Service of  
the Human Resources, Institutions and Agrarian Reform Division

FOREWORD

This publication has been prepared to assist extension personnel in planning and implementing extension programmes for the safe storage of foodgrain at farm level in developing countries. It presupposes that readers are familiar with the basic concepts and principles of extension work - its philosophy, objectives, methods, programme planning and evaluation techniques. It is also assumed that they are trained in methods of communication, and in the production and use of a range of audio-visual aids. These subjects are covered by a number of publications. <sup>1/</sup>

Foodgrain may be stored by persons other than farmers in the rural areas of developing countries. And whereas this handbook is written primarily with farmers in mind, the guidance given applies equally to small-scale storage of foodgrain by other members of the rural population.

The guide seeks to serve a two-fold purpose. First, it attempts to acquaint planners of extension programmes with some of the basic scientific principles on the safe storage of foodgrain, but only to the extent that these principles may be required for formulating an extension policy and drawing up extension programmes for use among farmers in developing countries. Since technical and scientific information is the very core of the extension message, extension workers are recommended to supplement the outlines presented by referring to the original scientific sources dealing with the subject, whenever necessary.

Secondly, the guide presents specific considerations which arose when a programme was being set up for the safe storage of foodgrain in India. Important among these is the availability of the materials and commodities required for the proper storage of foodgrain, the formulation of a valid and reliable code or package of practices, and the need for utilizing various channels of communication with those storing grain.

Although the material is drawn, for the most part, from experiences gained in implementing FAO's "Farm and Community Grain Storage" project in India, it should be relevant to conditions in many developing countries.

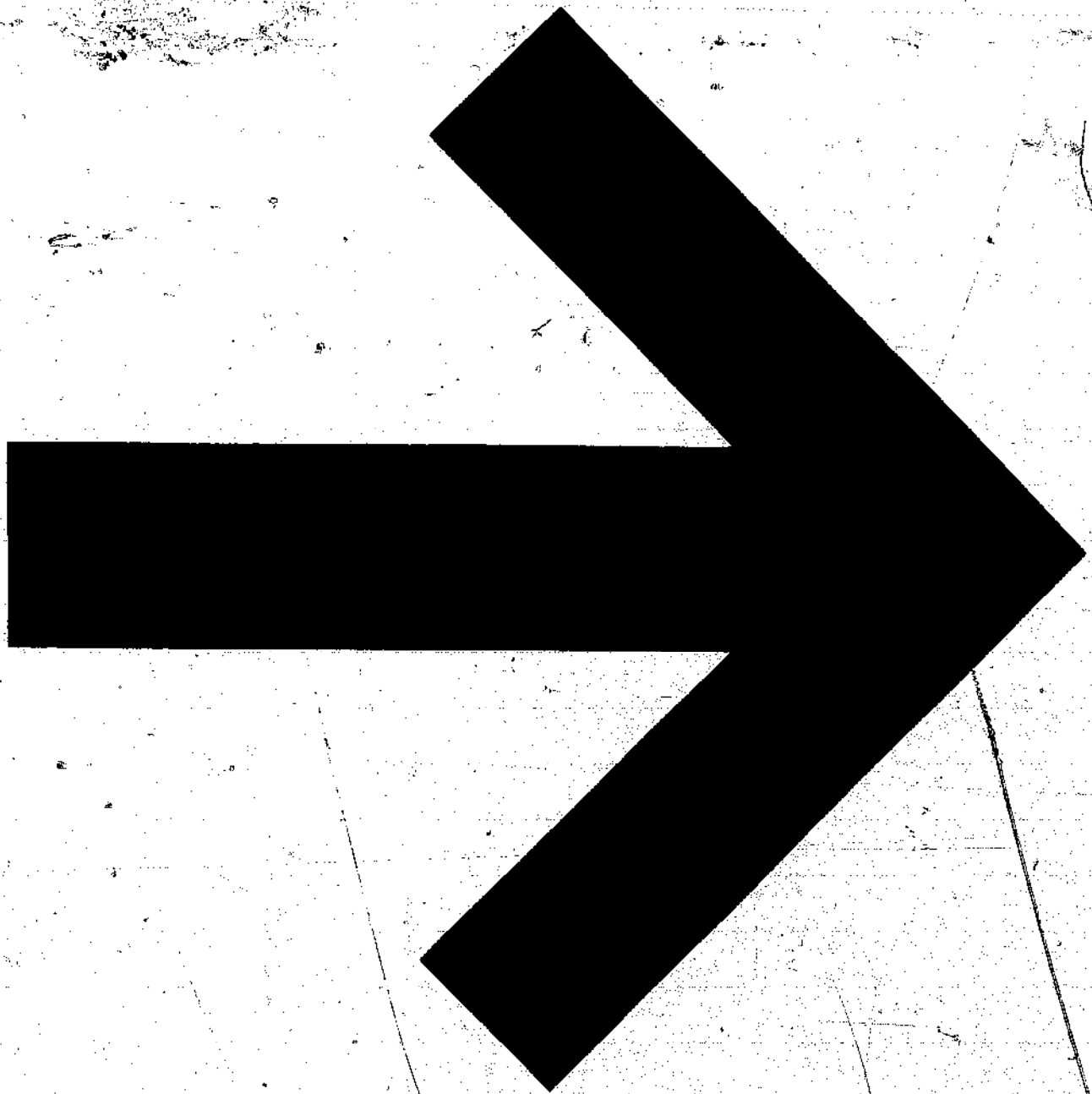
---

<sup>1/</sup> For example; Maunder, Addison H., Agricultural Extension: A Reference Manual, FAO, Rome, 1972.

Bradfield, D.J., Guide to Extension Training, FAO, Rome, 1966.

Botham, C.N., Audio-Visual Aids for Cooperative Education and Training, FAO, Rome, 1969.

Laughlin, T., Education and Extension Communication, FAO, Rome, 1974.



CONTENTSPage

<b>I. PLANNING EXTENSION PROGRAMMES FOR THE SAFE STORAGE OF FOODGRAIN</b>	
1. Assessment of the problem and establishing the potential economic benefits of the programme to the farmer.....	2
2. Formulation of a package of approved practices .....	3
3. Compatibility of recommendations with existing agricultural skills and socio-cultural values .....	4
4. Availability of materials for the proper storage of foodgrain .....	5
5. Setting up an organizational and administrative structure for the adoption of recommended practices .....	5
 <b>II. TRANSFORMING SCIENTIFIC PRINCIPLES INTO AN EXTENSION MESSAGE</b>	
Reasons for storing foodgrain .....	7
Accepted principles for the safe storage of foodgrain .....	7
Characteristics of an effective extension message .....	7
 <b>III. IMPLEMENTING THE EXTENSION PROGRAMME</b>	
Inclusion of "grain storage" in the "job-chart" of the field extension workers .....	23
Holding training courses .....	24
Extension aids and field activities .....	24
 <b><u>ANNEXES</u></b>	
I. Observations on grain in faulty storage conditions and the probable damaging agent resulting in the symptoms observed .....	31
II. Extracts from a document issued by the Department of Food, Government of India concerning the SAVE GRAIN CAMPAIGN .....	32

LIST OF ILLUSTRATIONS

<u>Fig.</u>		<u>Page</u>
1.	Grain damaged by insects .....	9
2.	Samples of sound and damaged grain .....	9
3.	Symptoms of moisture damage to stored foodgrain .....	10
4.	Bags of grain stored away from walls, on wooden crates, to control moisture damage .....	11
5.	Modern storage receptacle .....	12
6.	A metal base to straw-made structure .....	13
7.	Sun drying .....	14
8.	Five Golden Rules .....	14
9.	Rat attacking stored grain .....	15
10.	Extension worker giving a demonstration .....	15
11.)	Demonstration kit - a portable unit .....	{ 16
12.)		{ 16
13.	Both sides of demonstration kit serve as a flannelboard .....	17
14.	One side of the demonstration kit is for insect control; the other for rat control .....	17
15.	A local exhibition .....	18
16.	Effective use of wallboard .....	18
17.	A museum includes models, photos, samples, etc. ....	19
18.	A push-button map showing annual production .....	19
19.)	Examples of leaflets .....	{ 20
20.)		{ 21
21.	Example of poster .....	22



## I. PLANNING EXTENSION PROGRAMMES FOR THE SAFE STORAGE OF FOODGRAIN

The principles of planning and setting up extension programmes - determining objectives, assigning priorities, budgeting, phasing, and evaluating results - are well set out in many publications. They are directly applicable to planning programmes for the safe storage of foodgrain.

Nevertheless, some considerations deserve the special attention of extension personnel engaged in establishing foodgrain storage programmes. These considerations, based on experiences gained in India, have proved to be valid in drawing up programmes which have subsequently proved successful.

### Methods of Storage

Through the ages, farmers have devised ways and means of storing foodgrain <sup>1/</sup> from one year to another. It may be stored:

- a) indoors or outdoors
- b) underground, above ground, or partially underground
- c) in bulk, or in bags or containers
- d) in metal or non-metallic receptacles
- e) in indigenous or modern types of structure

Most farmers store their produce in bulk, in bags or in indigenous structures. If the quantity is large enough, they may devote a room or area to storing the produce.

### Losses: two main categories

Losses in foodgrain are usually classified under two main categories:

A. Pre-harvest losses are those which occur while the crop is still growing in the field. These are the result of plant diseases, insects, rodents, birds, weeds and physiological disorders related to crowding, incorrect fertilization, faulty seeding and irrigation, drainage and climatic conditions. In general, such losses are the concern of the agricultural or plant protection officers.

B. Post-harvest losses are those occurring after the crop has ripened. They include:

---

<sup>1/</sup> "Foodgrain" refers to the seed or seed-like fruit of cereal grass such as wheat, paddy, oats, sorghum (coarse grains), barley or maize (often known as corn). Farmers may also use the term to refer to pulses such as peas, beans and lentils.

## I. PLANNING EXTENSION PROGRAMMES FOR THE SAFE STORAGE OF FOODGRAIN

The principles of planning and setting up extension programmes - determining objectives, assigning priorities, budgeting, phasing, and evaluating results - are well set out in many publications. They are directly applicable to planning programmes for the safe storage of foodgrain.

Nevertheless, some considerations deserve the special attention of extension personnel engaged in establishing foodgrain storage programmes. These considerations, based on experiences gained in India, have proved to be valid in drawing up programmes which have subsequently proved successful.

### Methods of Storage

Through the ages, farmers have devised ways and means of storing foodgrain <sup>1/</sup> from one year to another. It may be stored:

- a) indoors or outdoors
- b) underground, above ground, or partially underground
- c) in bulk, or in bags or containers
- d) in metal or non-metallic receptacles
- e) in indigenous or modern types of structure

Most farmers store their produce in bulk, in bags or in indigenous structures. If the quantity is large enough, they may devote a room or area to storing the produce.

### Losses: two main categories

Losses in foodgrain are usually classified under two main categories:

A. Pre-harvest losses are those which occur while the crop is still growing in the field. These are the result of plant diseases, insects, rodents, birds, weeds and physiological disorders related to crowding, incorrect fertilization, faulty seeding and irrigation, drainage and climatic conditions. In general, such losses are the concern of the agricultural or plant protection officers.

B. Post-harvest losses are those occurring after the crop has ripened. They include:

---

<sup>1/</sup> "Foodgrain" refers to the seed or seed-like fruit of cereal grass such as wheat, paddy, oats, sorghum (coarse grains), barley or maize (often known as corn). Farmers may also use the term to refer to pulses such as peas, beans and lentils.

- (i) Wastage in the field while the crop is being harvested, usually as a result of "shattering" and "shedding" due to loss of moisture content when the crop is left too long in the field after reaching the harvest stage.
- (ii) Spillage during handling, usually while filling bags and containers, weighing, loading, transporting, unloading, etc.
- (iii) Losses in quantity and deterioration in quality as a result of bad storage conditions and practices which expose stored foodgrain to damaging agents. (Figs. 1, 2 and 3).

This guide is concerned with the losses occurring under item (iii).

An extension programme for storing foodgrain at the farm level must take into account:

- 1) assessment of the problem, and establishment of the potential economic benefit of the programme to the farmer
- 2) formulation of a package of approved practices
- 3) compatibility of recommendations with existing agricultural skills and socio-cultural values
- 4) availability of materials for proper storage of foodgrain
- 5) the organizational and administrative structure necessary for the adoption of recommended practices

1. Assessment of the problem, and establishing the potential economic benefits of the programme to the farmer

First, the extension adviser should recognize the existence of the grain storage problem in his area and estimate its magnitude. The problem should then be interpreted in terms of monetary loss to the individual farmer and related to the country's economic structure. Although a programme to reduce losses of stored foodgrain at the national level may be economically justifiable, this may not apply at the level of the individual farmer. Hence, the economic returns to be expected from undertaking a programme to prevent damage in stored foodgrain at the farm level should be clearly established, and the range of individual farmers who would benefit from such a programme should be defined. Economic investment must be justified in relation to potential monetary returns. In subsistence agriculture where farmers may be near the poverty line, economic investment may be both impractical and unjustified. For such farmers, a limited range of practices and the use of locally available materials will be more meaningful.

Normally much of the information required to establish the economic justification

These should determine the economic inputs and outputs of a storage campaign and define the range of farmers and others to be included. If such studies have not been made, extension advisers should arrange for them to be carried out. Economic justification for the contemplated programme is a pre-requisite for its planning.

When the problem has been defined and its dimensions and economic justification established, the extension planner should make himself acquainted with the local technical and socio-cultural standards with a bearing on the adoption of the recommended practices. He should build up his background knowledge and attempt to draw a general profile of:

- the kinds of foodgrain grown and harvesting seasons
- the average quantities stored and the normally expected range in these quantities
- the period of storage
- the indigenous methods of storage and storage structures (paying special attention to their advantages and disadvantages)
- the sources and extent of damage and the time of its occurrence

The extension planner should investigate the cultural environment in which he will be operating; and also find out the individual's awareness of, and interest in, the problems of grain storage. General information on the socio-cultural factors should be sought; and the role of women and children in home storage of foodgrain ascertained. Socio-religious values must be taken into account. All this can only be achieved by personal visits to the region in which the programme is to operate.

## 2. Formulation of a package of approved practices

The second step the extension adviser should take is to see that a definite "package of approved practices" or a "code of recommendations" is formulated. This is essential before planning and starting a programme.

The development of a package of practices, based on laboratory experiments and field tests, is the responsibility of the technical and scientific personnel. Although extension officers collaborate with the technical personnel in operating a two-way channel of communication between the laboratory and the field, they should realize their own limitations in dealing with the technical aspects of the matter. Extension officers should avoid the promotion of any measures which have not been endorsed and recommended by the technical personnel.

If a package of practices has been developed but not tested, steps to establish its application in the field at farm level should be taken as part of the testing programme and not as a demonstration. Testing a practice implies that results may prove to be unreliable or even negative. Farmers should be made aware of this possibility and not be expected to contribute financially when participating in testing programmes. All testing should be at the project's expense. Demonstrations, however, cannot afford to fail or to give unreliable results. They are given to the farmer as a proof and not simply as a possibility for successful storage. Once an extension demonstration fails to yield the desired results, farmers are apt to lose faith not only in the recommendations, but also in the extension agent himself.

The distinction between a test and a demonstration should therefore be made clear at the outset. Demonstrations can only be performed after practices have been fully tested and their reliability ascertained. There is a tendency among non-extension personnel to use the two terms "test" and "demonstration" interchangeably, thus creating some confusion in the farmer's mind regarding the work of the extension agent. Such confusion should not be allowed to arise. The role of the technical divisions is to test and develop a package of valid, reliable and applicable practices; the role of the extension agents is to propagate and popularize those practices among farmers.

3. Compatibility of recommendations with existing agricultural skills and socio-cultural values

The third step for the extension planner is to ensure the compatibility of the recommendations with local attitudes. To be accepted and adopted, recommendations should not only be technically and scientifically reliable, but must also be compatible with:

- existing farming practices
- socio-cultural values and the farmer's own situation

Recommendations which differ widely from practices predominant in the area may seem to be alien in the eyes of the farmers. It is of course possible to advocate principles and practices which have been successful in developed countries; but because such practices are not related to the local "socio-agronomical" structure, they may seem incongruous to the farmers, who reject them. The use of a metal bin, for example, for the storage of foodgrain may be accepted, but the improvement of storage receptacles made with locally available material will in fact be more in keeping with the farmers' experience.

Introduction of a new technique may result in a chain reaction in a whole range of agricultural practices. Consequently, full consideration must be given to timing the introduction of a new practice to fit in with other seasonal activities and to linking it with prevailing agricultural practices. Cleaning, disinfecting and whitewashing the storage structure should be timed to coincide with the pre-harvesting period when the farmer is not too busy, while sun-drying and cleaning foodgrain is easy to link with harvesting and threshing.

Extension recommendations should be presented in a way which conforms to the predominating value system and strengthens group coherence. For example, in traditional communities where women are assigned a conservative role in the home and their contact with men discouraged, it is inadvisable to have extension demonstrations carried out in their homes by men. In such cases, training extension women to carry out foodgrain storage demonstrations in homes has proved to be more successful. Similarly, respect for socio-cultural beliefs in communities which firmly believe in the continuity of life may require avoiding the "killing" of rats and insects in the extension recommendation, and substituting a term such as "eradication", "prevention" or "exclusion".

So long as such an extension message does not seem to constitute a threat to the community's socio-religious values and beliefs, it should be acceptable. It is therefore essential to obtain the cooperation of the opinion-makers and the religious and social leaders.

Two main considerations arise when formulating a package of practices.

The first is to promote practices and skills of various degrees of sophistication to correspond with the needs and abilities of the various categories of people. A subsistence farmer may be neither willing nor able to invest in pesticides. A package of practices should, therefore, emphasize improvement in existing methods. Other groups of farmers however may be knowledgeable and capable of adopting more sophisticated techniques to perfect their grain.

The second consideration to be observed in relation to a package of practices is that it should make provision to incorporate future recommendations. No package of practices can be considered as final.

4. Availability of materials for the proper storage of foodgrain

The fourth step for the extension adviser is that he must investigate the availability of the materials required. Extension planners must ensure that the materials necessary for the implementation of the recommendations, along with the spare parts and facilities for repairs, are within reach of the farmers.

Displaying storage structures of various sizes, insecticides (dusts, sprays, fumigants or whatever local recommendations may be), other pesticides, along with polythene material, floor straw mats, wooden crates, cages, traps, wire-gauze, etc., at farmers' gatherings and local exhibitions always raises the question of their availability. Information must be supplied on how and where to obtain materials provided at the display: their availability may be the determining factor in implementing the extension programme.

Arrangements should be made to supply cooperatives or dealers with bins of various sizes, anticoagulants, insecticides, dunnage material <sup>1/</sup> etc. These may be supplied to the farmers free of charge if for testing purposes only; but farmers should be willing to purchase them at their own expense, if the extension activity is successful. Supplying farmers with materials free of charge is not normally an extension activity. The volume of purchases of the various recommended materials can be used as an index of the extent to which the programme has been adopted and the use of these figures for evaluation purposes should not be overlooked.

At the national level, establishing a system to ensure the availability of materials will involve a number of considerations. One will be the country's preference to assign the manufacture or supply of these commodities to the public or to the private sector of the economy. Another important consideration is whether the country can provide the materials or they have to be imported. In some Indian states, responsibility for supplying these materials has been monopolized by the public sector. In others, the private sector has been assigned this responsibility; or the public sector has delegated the production and distribution of storage materials to special dealers, thus assuring some measure of control over their quality.

5. Setting up an organizational and administrative structure for the adoption of recommended practices

The fifth step the extension planner should take is to formulate the strategy to be followed to ensure the impact of the extension activity. The following points should be considered in advance:

- The potential public (olientele, i.e. persons for whom the information is intended)
- The machinery for implementing the programme
- The extent and intensity of the work required
- Budgeting, phasing and follow-up evaluation

Although the extension adviser is in a strong position to contribute to the development of the implementation strategy, full discussion should subsequently take place with the responsible national authorities who will continue the work.

<sup>1/</sup> Dunnage is material used to prevent moisture accumulation and transfer to foodgrains stored in bags, e.g. polythene material, wooden slats or crates to keep the bags off the ground, or other devices to control moisture damage to the base of stored foodgrain. (Fig. 4).

Recommendations for the complete preservation of stored grain require considerable economic investment and hence will be limited to farmers and merchants with access to capital. Practices for some improvement in the safety of storage of foodgrain can, however, be propagated among subsistence farmers who can bear little monetary burden.

In terms of economic returns, it is certainly preferable to start with those with higher incomes. Usually these farmers are also more receptive to modern ideas and methods. In addition, by adopting the recommended practices, these farmers help to establish a "progressive spiral movement" often resulting in the less receptive cultivators also adopting the new storage practices. The strategy adopted however should also recognize the importance of promoting the safe storage of foodgrain at the subsistence farm level.

In evolving machinery for implementing the programme, consideration should be given to the possibility of utilizing the facilities of existing agencies rather than creating new ones. Activities on the storage of foodgrain should be an integral part of the work of the local extension service. In India, however, a special agency has been set up under the "Save Grain Campaign". An office established in each state maintains liaison with the central government. While the technical divisions are responsible for developing ideas and testing them for practical results, the "Save Grain Campaign" acts as the policy-making machinery responsible for developing and implementing a national plan. It is empowered to utilize fully the communication channels and to establish liaison with all parties interested in the storage of foodgrain. There should be no duplication or overlapping in the functions of the various agencies engaged in carrying out extension activities; these should be assigned to the extension division. The "Save Grain" machinery confines itself to development and evaluation of the national plan.

Information on the safe storage of foodgrain should be introduced to both the formal and informal channels of education. Reading material on the importance of grain, its proper storage, source of damage (rats, insects, birds), etc. should be progressively included in the curriculum of the primary school. Courses on storage should be established at all levels of agricultural education. Attempts should also be made to include rat and insect eradication in the activities of youth clubs such as Future Farmer and 4-H groups; and information on the practical aspects of grain storage should be incorporated in adult education, functional literacy and farmer training classes.

Training courses for extension personnel should include information on the preparation and use of special extension aids for both men's and women's courses. Plant protection officers and manufacturers of storage receptacles, etc., should also receive training. In developing the syllabuses special emphasis should be given to practical skills. Any tendency to over-emphasize the importance of academic research should be avoided and priority given to practical information, empirical tests, and the development of skills to safeguard stored grain. During the initial phase, it is appropriate to use simple techniques to bring the problem of grain storage to the notice of farmers as a prelude to a more intensified campaign using all channels of communication and extension methods. Such intensification should not be started until practical preparations, including those for training, availability of materials, etc., have been finalized. The inevitable time lag between receiving the message and adopting it should be taken into consideration when developing the strategy. Programmes should be started 2-3 months before harvesting and gradually accelerated to bring them to a peak a month before harvest and to strive for another peak shortly after the harvesting season.



## II. TRANSFORMING SCIENTIFIC PRINCIPLES INTO AN EXTENSION MESSAGE

### Reasons for storing foodgrain

Foodgrain is stored by farmers and villagers for one or more of the following reasons:

- a) home consumption
- b) seed for the next crop
- c) marketing late in the season when prices improve
- d) feeding animals and poultry
- e) socio-cultural reasons, such as gifts in marriages or births, and for religious purposes, such as offerings.

### Accepted principles for the safe storage of foodgrain

The principles of foodgrain storage are well known. They are as follows:

- observing proper storage management and sanitary measures
- using scientifically-tested receptacles (Figs. 5 and 6).
- storing the grain at optimum moisture content throughout the storage period
- controlling insect infestation
- controlling rat and bird damage

These principles have proved valid under all conditions; but before they become of practical value to the farmer, they must be transformed into a package of practices emphasizing specific techniques and skills. When those practices are finally field tested under the prevailing climatic conditions and their reliability established within the socio-cultural environment, they are considered as a package of approved practices and incorporated into the extension message.

### Characteristics of an effective extension message

Whether oral, written, visual or audio-visual, the extension message should have a number of specific characteristics.

1. Ear and eye-catching. Farmers are selective in their perception and become more receptive as the message touches upon their needs. "More Grain" for example is catching when there is a shortage of grain. "More Money" is a better caption when there is a surplus of grain. The two captions are not interchangeable; each is more effective under certain conditions. When there is a shortage of grain most farmers are more concerned with having more grain than more money.



2. Psychologically expressed. The contents should be psychologically expressed so as to answer felt needs immediately and directly or to bring such needs to the awareness of the farmer. Sentences such as "Do you know you are losing a tenth of your produce while in storage?", and "Rats and insects are eating your children's food", or "Do you want to stop insects and rats from damaging your stored grain?" make a strong impact on the farmer.

3. Simple and concise. Facts should be stated in a direct, simple and concise way. Farmers are more concerned with facts than with their detailed interpretation and explanation. "DRY YOUR GRAIN" is more to the point than "Grains should be dried before storage", or, even worse, "The importance of drying the new produce before storing it cannot be overemphasized". (Fig. 7).

4. Non-technical wording. Technical terminology should be kept to a minimum. The extension message should be given in the community's local language and vocabulary, and visual material should depict life in the community. Although the extension message may be drafted in a language other than that of the community, it should be translated, and preferably tested for comprehension and perception before being finally released.

5. Emphasizing skills rather than information. The extension message should lead to the adoption of specific skills to reduce losses of stored grain. Farmers are more interested in knowing "How to do" rather than merely "Why".

6. An entity in itself. The extension message should yield results without reference to other messages. It should list all the skills required for the specific purpose for which it is formulated. "Apply the Five Golden Rules" is an entity. "How to control insects in stored grain", "How to control rodents by using anticoagulants", etc., should each provide all answers to the question in a practical way so that there is no need to consult further references -- although attention may be drawn to these so as to provide further clarification, if needed. (Fig. 8).

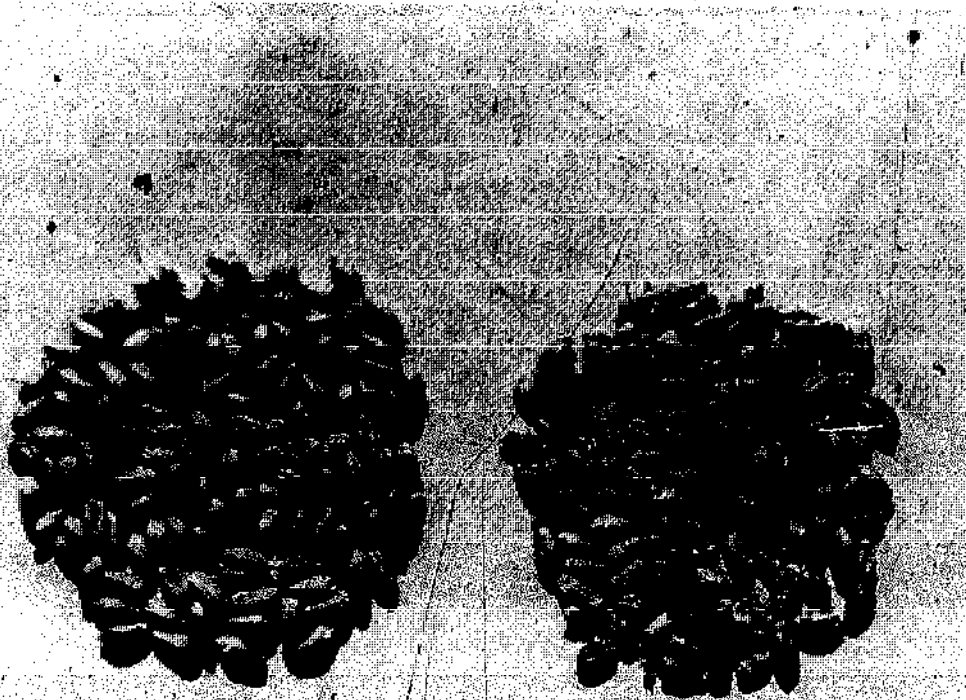
7. In the imperative. The extension message should be stated in the imperative to avoid any ambiguity. "Use dunnage to avoid moisture damage to stored foodgrain", "Use domestic bins", "Put baits in rat paths", "Break the EDB ampoule" and "Disinfest your storage structure" are examples of the imperative.

8. Visual or visualizable. It is universally held that "Seeing is believing". To be effective, therefore, the extension message should be visual or visualizable. Demonstrations are usually self-evident. In written or printed messages, a picture is worth many words. More pictures and few words should be used to explain the message.

9. Calling for action "Now". A feeling of urgency should be created. Farmers tend to be hesitant in implementing technical recommendations. The extension message should therefore create the impression of urgency if farmers are to respond.



(Fig. 1)  
Grain damaged by insects



(Fig. 2)  
Samples of sound and damaged grain



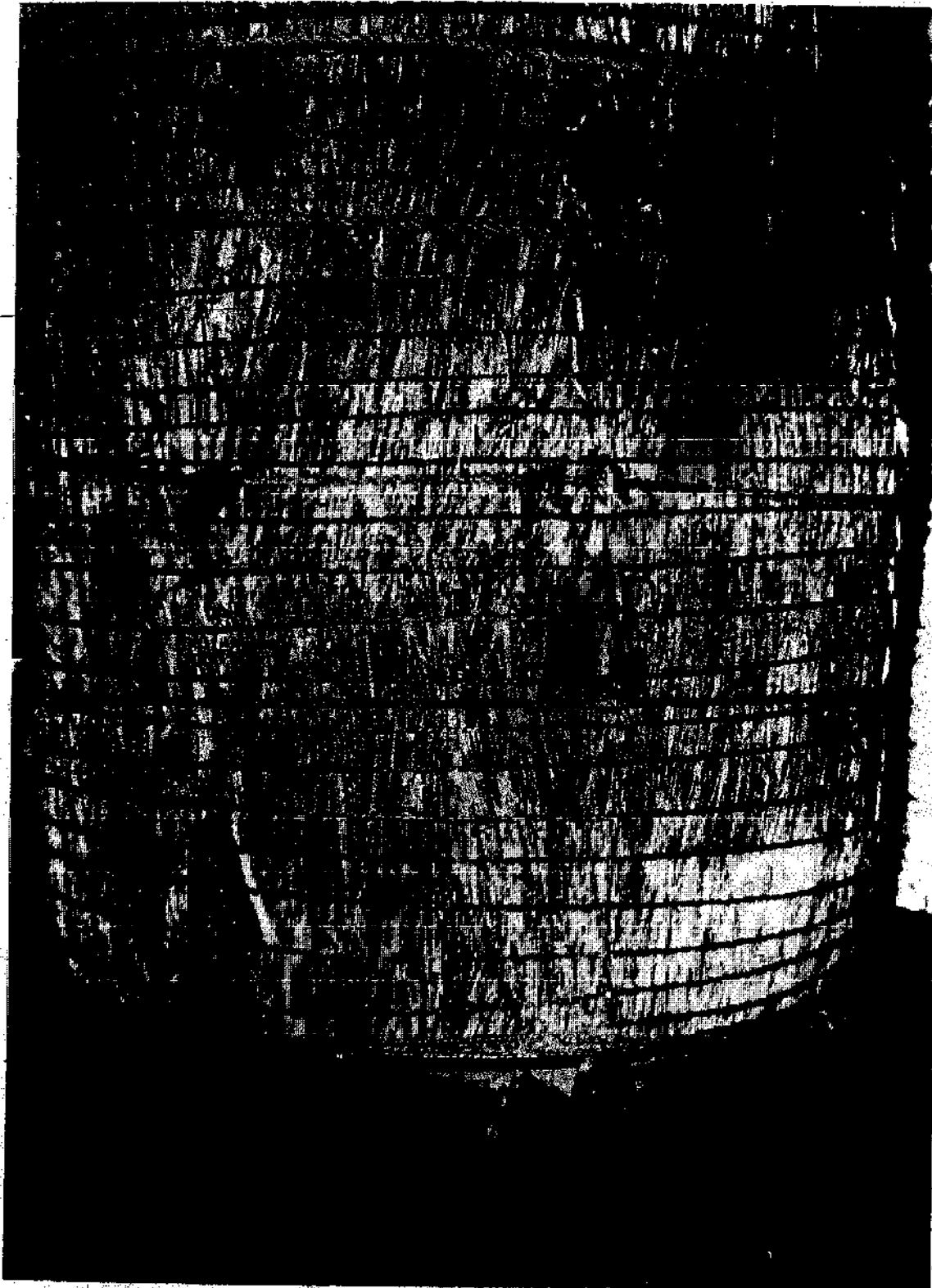
(Fig. 3)  
Symptoms of moisture damage to stored foodgrain



(Fig. 4)  
Bags of grain stored away from walls,  
on wooden crates, to control moisture damage



(Fig. 5)  
Modern storage receptacle



(Fig.6)  
A metal base to straw-made structure



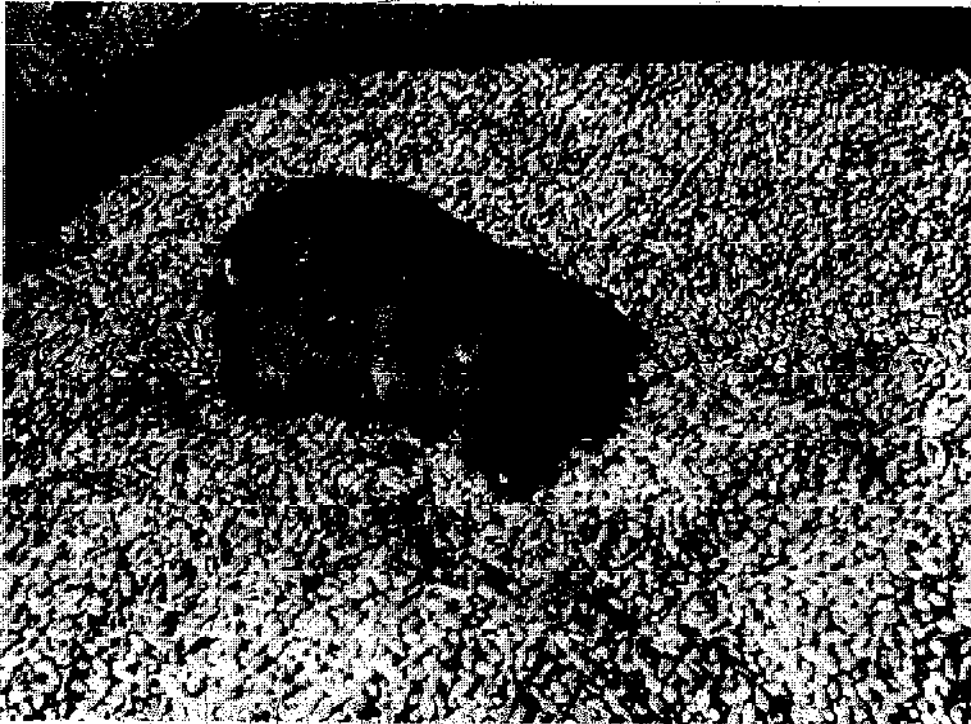


(Fig. 7)  
Sun drying

*Apply the 5 Golden Rules*

- DRY AND CLEAN YOUR GRAIN BEFORE STORING.
- USE DUNNAGE TO AVOID MOISTURE DAMAGE TO GRAIN STORED IN BAGS.
- USE DOMESTIC BINS OR IMPROVE YOUR STORAGE STRUCTURE.
- FUMIGATE WITH EDB AMPOULES TO AVOID INSECT DAMAGE.
- USE ANTICOAGULANT FOR RAT CONTROL.

(Fig. 8)  
Five Golden Rules

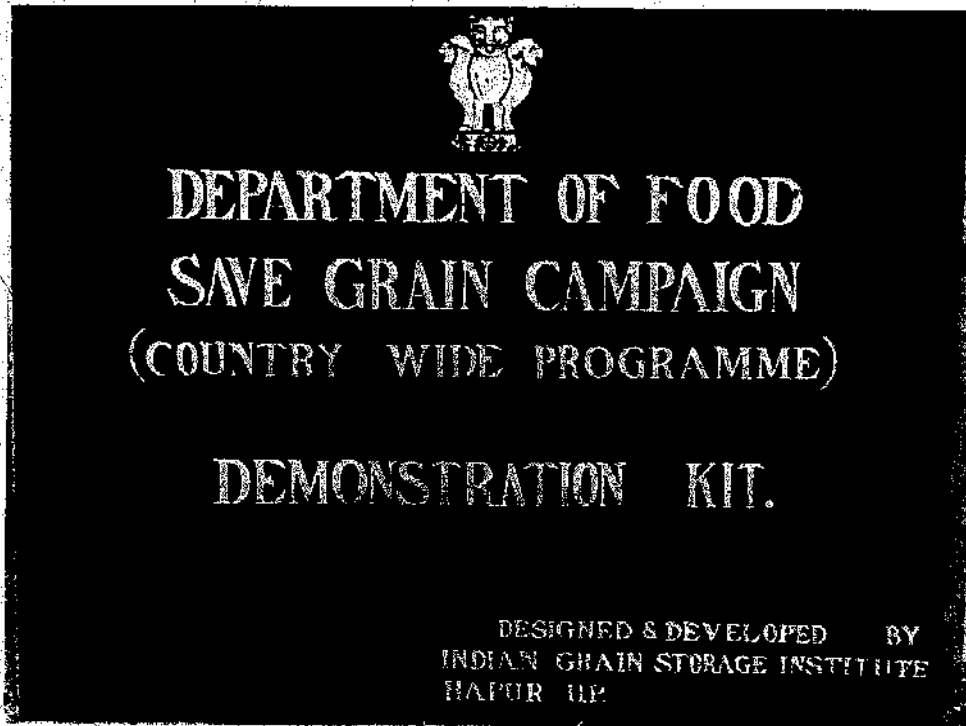


(Fig. 9)  
Rat attacking stored grain



(Fig. 10)  
Extension worker giving a demonstration





(Fig. 11)



(Fig. 12)

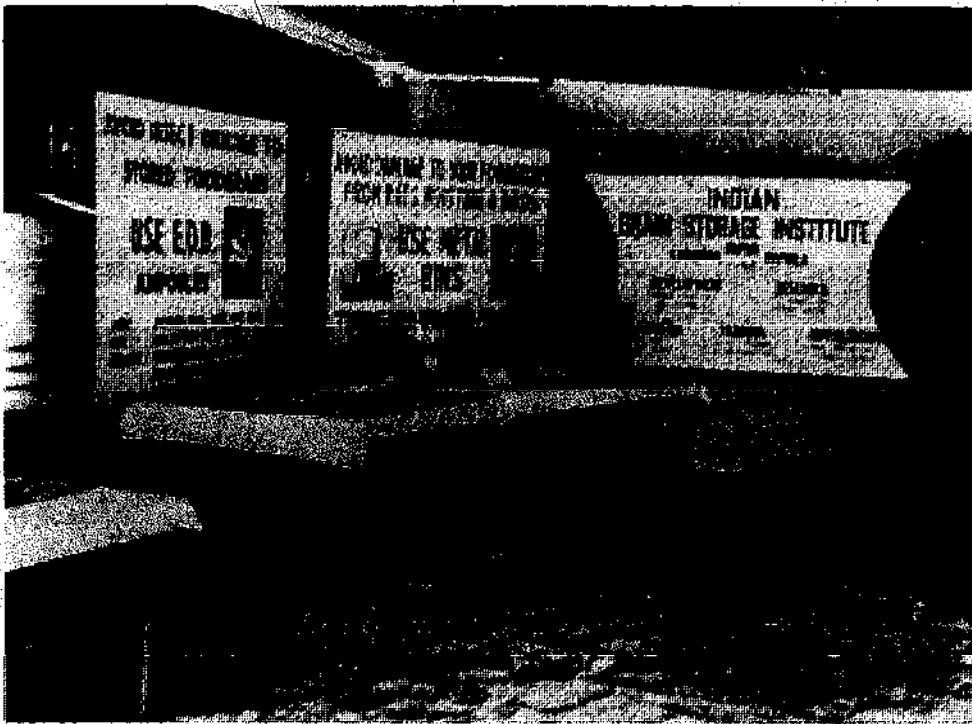
Demonstration Kit - a portable unit



(Fig. 13)  
Both sides of demonstration kit  
serve as a flannelboard



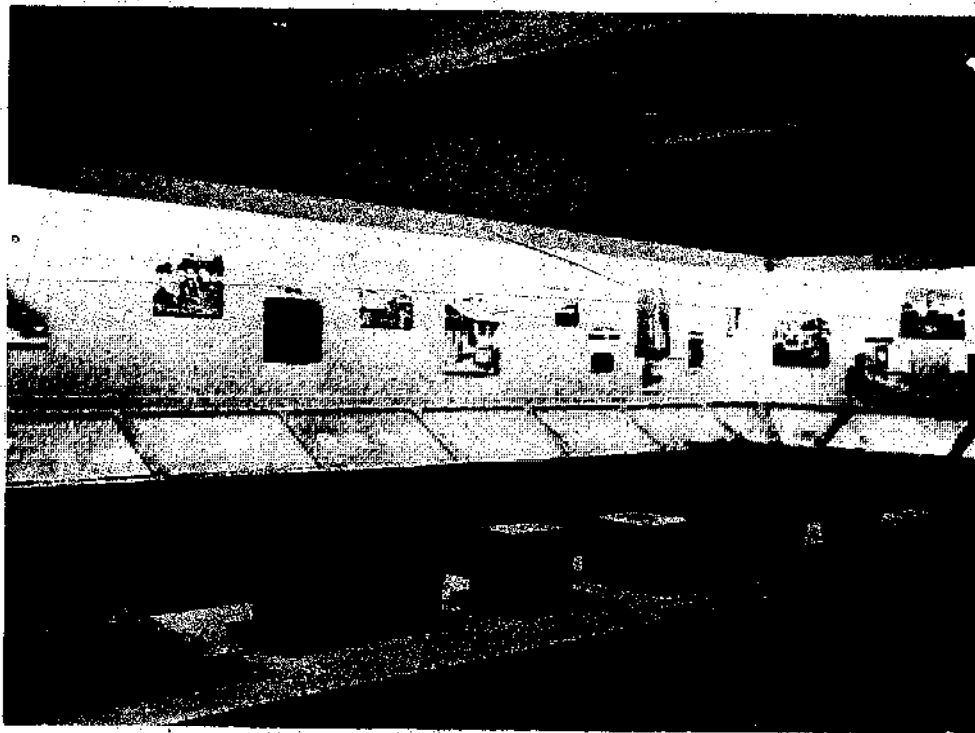
(Fig. 14)  
One side of the demonstration kit is for insect control;  
the other for rat control



(Fig. 15)  
A local exhibition.



(Fig. 16)  
Effective use of wallboard



(Fig. 17)  
A museum includes models, photos, samples, etc.



(Fig. 18)  
A push-button map showing annual production

# SAVE GRAIN

## RATS - THEIR IDENTIFICATION & HABITS



Scientific name :	<i>Rattus rattus</i>	<i>Rattus norvegicus</i>	<i>Bandicota indica</i>	<i>Bandicota bengalensis</i>
Common name :	House or common rat	Brown or sewer rat	Bandicoot rat	Linear bandicoot rat
Weight :	250 gms.	330 gms.	800-1000 gms.	300 gms.
Tail length :	Longer than head & body.	Shorter than head & body.	Equal to length of head & body not uniformly tapering.	Less than, sometimes equal to length of head & body together.
Ears :	Translucent, large & hairless	Thick, opaque, short	Short & opaque	Thick & opaque
Snout :	Petioled	Wide & blunt	Broad & slightly longish.	Short, strongly piglike.
Fur & body colour :	Soft, gray to black.	Soft, brownish grey, white belly.	Coarse with sparse black to blackish brown with white hairs.	Coarse, dark brown, occasionally blackish.
Droppings :	Scattered, bean-like shape	In groups, spindle shaped	Scattered, big spindle.	Scattered & oval
Habits :	Rarely burrows, climbs trees in houses	Burrowing, climbing & swims well, lives in sewers.	Burrows profusely, lives in fields & outside houses	Burrowing habit. Depth of burrows 18-25 inches ramified covering a length of 100 feet.
Distribution :	Found in towns & villages, inside houses & stores	Found in ports & inland towns.	Found in fields & outside houses & godowns	Found in towns, fields & godowns

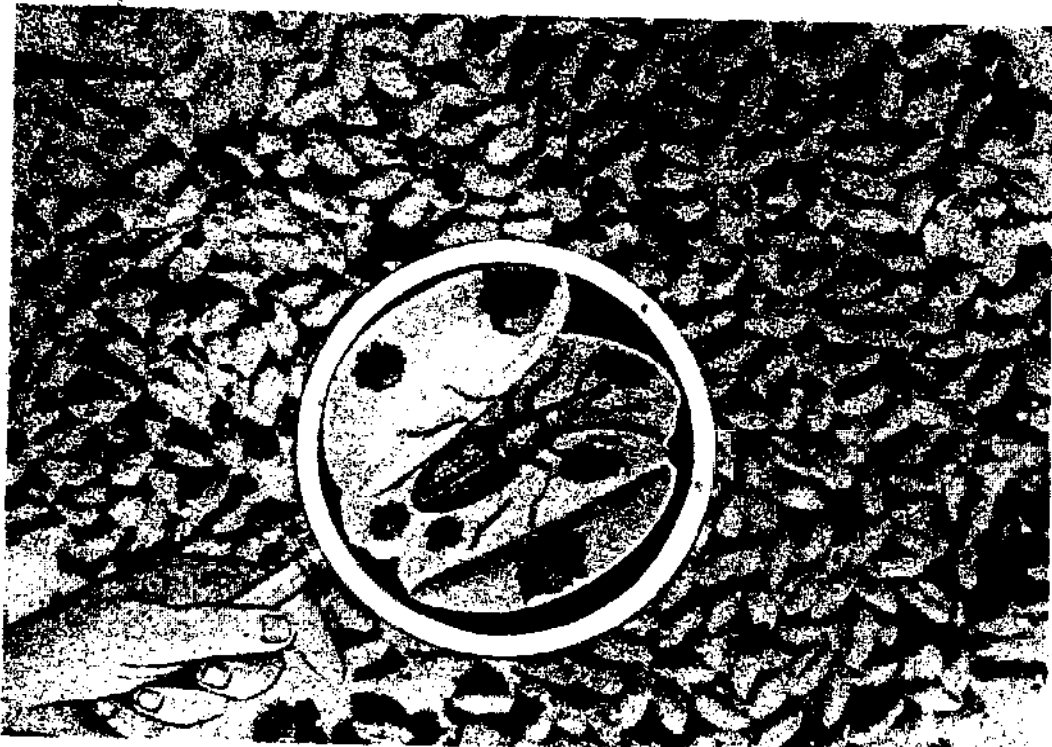
### You can find them



**DEVELOPED BY :**  
**Indian Grain Storage Institute, HAPUR (U.P.)**

(Fig. 19)  
 Example of Leaflet

INSECTS ENCOUNTERED IN  
HANDLING OF FOOD GRAINS  
AND THEIR CONTROL



Prepared by

Grain Storage Research & Training Institute,  
Govt. of India - Ministry of Food and Agriculture  
Department of Food  
Hapur (U.P.).

LEAFLET NO. 1

26th Jan 1964

(Fig. 20)

Example of Leaflet

उन्न सुरक्षा अभियान



# अनाज की रक्षा कैसे...



- कीड़ों से बचाव के लिये ई.डी.बी. से धूनी दें।
- चूहा नाशक दवाओं का प्रयोग करें।
- टीन की टंकी या कुठला कोठली में सुरक्षित रखें।

अधिक जानकारी के लिये अपने खण्ड विकास अधिकारी से मिलें।

उन्न सुरक्षा अभियान के अन्तर्गत  
अनाज, खाद्य एवं कृषि उत्पादों की सुरक्षा के लिये  
आज हम सब मिलकर कार्य करेंगे।

(Fig. 21)  
Example of Poster

### III. IMPLEMENTING THE EXTENSION PROGRAMME

After a plan is developed, a package of approved practices formulated, an organizational and administrative structure supporting their adoption set up, and arrangements made for the availability of the materials, consideration should be given to the gradual implementation of the extension programme.

#### Inclusion of "grain storage" in the "job-chart" of the field extension workers

Where the duties of the field extension worker are already formally defined and performed according to a developed scheme of work, "grain storage" must be included officially in his "job-chart". This will of course be done by channelling the recommendations through the government offices at various levels. The fact that the crop storage work of the field extension worker takes place mostly during a time when other duties are less demanding should be emphasized if the storage of foodgrain is to be included in the "job-chart".

Field extension workers should always receive adequate practical training. It is important that such training be given before the extension agents undertake any field activity. They should receive short "crash" courses of 5-7 days' duration on the safe storage of foodgrain at farm level. Subject to the need to devote time to developing special audio-visual aids, these short courses for intensive training should be intensified as soon as possible. The syllabus should be based on purely practical considerations and avoid superfluous background information. Emphasis is usually placed on three main aspects:

- actual storage conditions and practices at farm level in the area
- sources and extent of damage
- application of practical measures to control damage to stored foodgrain

Attention must be given to training these workers in how to conduct demonstrations for farmers. The development of skills and their application cannot be over-emphasized. Field extension agents should be able to show the farmers how to safeguard their stored foodgrain. Important as it is, training in extension techniques should not overshadow the development of technical skills. (Fig.10).

Where there is a shortage of trained field extension workers, then village leaders and volunteers (men and women) should receive direct practical training. In such cases emphasis should be placed only on:

- symptoms and sources of damage
- skills and practices to control damage

A one-day training course may be sufficient. Volunteers make a significant contribution to the implementation of such a programme and can be recruited from the "community-minded" youth of the village. Nevertheless, to ensure the effectiveness of their efforts, activities should be organized under the close supervision of the extension agent.



### Holding training courses

To ensure the full impact of the approved practices, recommendations on the safe storage of foodgrain should be implemented and adopted by farmers at the national level. This, in turn, will require the training of:

- trainers
- extension workers
- farmers and farm women
- private manufacturers and suppliers of storage structures and other commodities necessary for improved grain storage

Although to begin with short-term courses of only 2-5 days are necessary, provision should be made for longer-term courses at a later stage of implementation.

The content of each training course should be developed by subject matter officers, emphasis being shifted from the theoretical to the practical as the course gets shorter and closer to the farmers. Since scientific and technical personnel, such as entomologists, chemists, microbiologists and engineers will concern themselves with scientific and technical details, the framework of the training course should be prepared by the extension agent after consultation. As already mentioned, more emphasis should be put on the development of skills than on academic and scientific information.

The training of trainers should take top priority. It is they who will impart training to field extension workers who, in turn, are in direct touch with the farmers. Plant protection officers, extension planners and administrators should receive specific training.

The training of women leaders and home economics extension workers should also receive proper attention. In many cases, bringing to the attention of women easily adopted practices to save foodgrain has proved more expeditious than waiting to develop a whole network for the propagation of practices among the farmers.

If the acquisition of domestic storage receptacles - metal or other types of bin - constitutes one of the approved practices, private and public manufacturers should receive training in making the approved type of receptacle.

In training the various categories of personnel engaged in the preservation of foodgrain, a "Comprehensive Training Scheme" on a systematic and regular basis should be adopted to ensure the continuity of extension activities. Training should be a continuous operation to keep extension and related workers up to date with new research findings.

### Extension aids and field activities

The various channels of communication for carrying the extension message are the subject of many manuals on the use of audio-visual aids. Selection of the appropriate channel of communication depends on the number of farmers to be reached and their characteristics. Individual, group and mass media serve different purposes and each has its own advantages. To create awareness, especially at the beginning of a campaign, the use of mass media: radio, local exhibitions, motion pictures, etc., are the most appropriate; whereas method-and-result demonstrations carried out for a limited number of persons are the most effective way of developing skills.

In selecting the proper channel for communicating the extension message, the characteristics of the recipients should be observed. In developing countries many farmers are illiterate. Written material is not therefore effective and demonstrations may be expected to yield better results. Nevertheless, it should be noted that where adult illiteracy is widespread, young people may well act as "carriers" of the extension message to their elders.

In general, extension audio-visual aids which have proved successful are:

### 1. Demonstration Kit

Method-and-result demonstrations represent one of the basic extension methods as they are based on the concepts of "seeing is believing" and the transfer of skills through actual participation. Practices for the safe storage of foodgrain readily offer themselves for demonstration purposes.

In India, for example, a kit containing all the materials for demonstrating practices on the safe storage of foodgrain has been developed for use by village extension workers. The demonstration kit is in the form of a sturdily made portable suitcase. The kit has two sides, the first being devoted to the control of insect damage. It includes materials and models, each in a separate compartment, as follows:

Two jars showing infested and sound grain

One magnifying glass

One sampling probe

Two ampoules each of EDB, EDB+ and EDCT (fumigants - ethylene dibromide; ethylene dibromide plus carbon tetrachloride; and ethylene dichloride plus carbon tetrachloride).

A piece of string

A piece of stone

A stick of reasonable length

Six small model grain bags

A small model of a wooden crate or rack

A piece of polythene sheet

A piece of fumigation cover

A small sieve

The second part of the kit concerns the avoidance of rat damage to foodgrain stored at home and the control of rodents in the surroundings. It includes the following articles, each in a separate compartment:

A package of anticoagulant powder

One small plate and spoon

Models of bait station and bait container

A small packet of zinc phosphide

A container of aluminium phosphide tablets

In addition, it includes literature on grain storage practices, a manual, and some photographs for display.

The two sides are covered with a flannelboard on which the photographs or pictorial material can be displayed.

A manual on "How to use the demonstration kit on grain storage" is an integral part of the Kit. It explains in detail and with full illustrations, the step-by-step procedures for performing the demonstrations. It links the subject matter with the extension methodology - "How to plan a demonstration", "What to do before giving a demonstration", "Starting the demonstration", etc., up to "Closing the demonstration".

The components of the kit will be determined according to the package of approved practices as developed locally. (Figs. 11, 12, 13 and 14).

## 2. Local exhibitions (Fig. 15)

Local exhibitions can be very effective in arousing interest among farmers. The use of loud music and singing, coloured tents, display stalls and foodstands always attract crowds of people. Farmers enjoy visiting such exhibitions and usually bring their families. They learn by observing the grain storage methods displayed and discussing them with other farmers.

Local exhibitions on safe storage of foodgrain may include:

(a) An enlarged model of a coloured rat made of light cardboard or plywood for attraction. If it is supported in the right place by a nail, it will move in the breeze as if eating from a plate in front of it. A huge coloured insect can also attract attention.

(b) Living insects under strong magnification are always an attraction. Highly infested grain should be put in a Petri dish under a lens to show the insects in action. Another magnified sample of grain damaged by moisture and a third of sound grain give a strong and convincing demonstration.

(c) Live rats can be displayed in cages (care being taken to see no one can be bitten by them).

(d) Captions should be prepared using short concise sentences.

(e) Samples of insecticides and raticides can be displayed showing costs and potential returns.

(f) Illustrations of the methods of correct bag storage of foodgrain by use of wooden crates or racks, polythene material, fumigation equipment, actual bins of various sizes, etc.

(g) Photographs, models of indigenous structures, etc.

## 3. Mobile exhibitions

For immediate participation at village fairs, a mobile exhibition can be prepared. It should consist of 6-7 boxes containing the various articles to be displayed: among them:

(a) Boxes 1-3: contain 12-15 table-top display boards with stands.

(b) Box 4: contains four magnifying lenses (if a portable magnifying unit is not available), four Petri dishes, samples of grain damaged by insects, moisture, rats, and a sample of sound grain.

(c) Box 5: contains samples of insecticides, raticides, cages, traps, sieves, probes, model of wooden crate and polythene material.

- (d) Box 6: contains models of recommended receptacles.
- (e) Box 7: contains the necessary ancillary materials: sheets of coloured paper, nails and hammer, scissors, pins, screwdriver, etc., and a group of cardboard captions in the local language.

#### 4. Slide stories

Although filmstrips can be developed in a compact form, they may prove difficult to use since not all machines can project them. Colour transparencies are a good alternative. They can be prepared in a series of up to 36 (enough for one projector magazine) to depict a story of a general nature (with some human element in it) and illustrating the sources of grain damage and control.

Slide stories in proper sequence, dealing with a single concept only, such as "Insect Control", "Rat Control" or "Reducing Moisture Damage to Stored Foodgrain", can also be prepared to illustrate specific techniques and practices.

Slide sequences of a general nature or those depicting single concepts should be accompanied by a full narrative. Groups of slides shown in a sequence should include an explanation of each slide as it is projected on the screen. If the necessary equipment is available, the narrative can be pre-recorded and the projector and tape recorder synchronized either automatically or manually.

#### 5. Calendars

Farmers are more likely to keep a calendar than a leaflet (especially a colour calendar). Calendars based on socio-religious concepts, when appropriate, can also feature in large print the "DOs" and "DON'Ts" on grain storage practices. As calendars are hanging on the wall for twelve months, farmers and their families are likely to note and put into practice the instructions given.

#### 6. Museums (or permanent displays) (Fig. 17).

A permanent museum (or permanent display) of an educational and historical nature can be an effective tool for training. Suitable items on the storage of foodgrain are:

- (a) models of storage structures in the region and country
- (b) models of modern scientifically developed structures
- (c) samples of foodgrain grown throughout the country
- (d) sources of damage to foodgrain
- (e) agents of damage to stored foodgrain:
  - (i) insects (under strong magnification)
  - (ii) micro-organisms (under strong magnification)
  - (iii) live rodents (securely caged)
  - (iv) mites (under strong magnification)
- (f) models of enlarged insects
- (g) equipment: probes, sieves, wooden crates or racks, moisture meters, sprays, fumigation material

- (h) a scientifically classified, entomological collection of insects which attack stored foodgrain
- (i) enlarged coloured and black-and-white photos, wooden or illuminated columns (histograms), push-button maps showing production by year, by State, etc. (Fig. 18).
- (j) samples of insecticides, raticides, traps, cages
- (k) models of correct methods of storage, wooden crates, etc.

#### 7. Handout leaflets

Handout leaflets are appropriate for exhibitions and mass meetings of the general public. They bring the problem to the attention of the reader and refer to the various authorities who can help. (Figs. 19 and 20).

#### 8. Subject-matter leaflets

- (a) of a general nature listing the problems and their possible solutions
- (b) of a specific nature, i.e. each leaflet dealing with one subject and emphasizing the "How to.....", such as:

- How to store maize
- How to store paddy
- How to avoid moisture damage
- How to control insect damage
- How to control rodent damage

#### 9. Posters and charts

Posters are used in public places as "eye-catching" and not as reading material. Charts depicting insects, rats and their life-cycle, damage, etc. can be developed as an educational aid for training. (Fig. 21).

#### 10. Pictorial pamphlets

Where there is a shortage of trained personnel, extension work can be concentrated in one or two small villages; a "model village" or a "demonstration village" can be developed to demonstrate the effectiveness of the recommendations.

Development of model or demonstration villages can also assist in evaluating progress. It should be clear however that while the development of the village itself entails an experimental extension approach, the storage practices are carried out as a demonstration, not as a testing activity. Field testing of technical ideas should not be included in demonstration villages; only valid and reliable practices should be demonstrated. Villages chosen for intensive demonstrations and the study of various practices should contain not more than 100-200 families near to the project centre, and should be under continuous observation.

The procedure for the development of a demonstration village includes:

- (a) Approaches to the village's formal, informal and socio-religious leaders to discuss the problem of grain storage. Samples of infested grain should be displayed under magnification to create interest.
- (b) Arrangement of method-and-result demonstrations to establish the soundness of the recommendations and to obtain support for developing the village as a model. Invitations should be extended to visit the project site.
- (c) Survey of the village for types of storage, quantities of grain stored, period of storage, etc. A simple record form should be prepared for recording the findings.
- (d) Allocation of the responsibility for providing materials to the village general store, or to a volunteer leader.
- (e) Holding of a small village fair. The mobile exhibition unit can provide the display.
- (f) Implementing various extension methods separately with a time lag between each. The number of farmers who adopt each practice should be recorded.
- (g) Holding slide shows, guided group discussions and contacting the farmers personally to study their reactions and responses.
- (h) Recording the quantities of articles which are bought from the store or volunteers will assist in evaluating progress.

12. Tealegraphs, flipbooks, flipcharts, flash cards, film and traditional media

All these aids can also be used to communicate a general or specific concept. A narrative can be prepared to appear in a flipbook or on flash cards. The subject matter should be arranged to depict the content of the extension message in a simple way. Emphasis should be put on the sources of damage and the correct methods of storage. Traditional media such as songs, folk tales and short plays have also proved very effective in bringing agricultural problems to the awareness of farmers.

Evaluating progress in implementing the extension programme

Progress in reaching the main objective of the extension programme, to ensure that farmers prevent their stored foodgrain being damaged, should be continuously evaluated. It may be difficult to get quantitative data on the increase of undamaged foodgrain resulting from the programme, but efforts should be made toward this end, directly or indirectly.

Initially, provision for measuring the quantitative and qualitative aspects should be made. In limited projects confined to a specific area, the evaluation process can be carried out if the procedures have been agreed upon at the outset. In a model village the number of farmers, farm wives, traders, etc., who adopt the recommended practices is an index of the effectiveness of both the extension method and the storage techniques used.

Another source of evaluation is the quantity of the relevant articles sold by the agent in the area. The number of bins and the quantities of insecticide or raticide purchased can also be a good indication of progress. In a larger area or on a national scale, it may be possible to determine the amounts of steel or timber (for bins and dunnage), and chemicals (for insecticides and rodenticides) that have been used.

In many cases however it may suffice to use the "observation method" if quantitative assessments are not possible. In his daily meetings with the farmers, through group discussions, interest shown in local exhibitions, etc., the extension agent can make general assessments of progress and identify reasons for any delay in implementing the recommendations. Farmers will express their views on the programme and its purposes; they will criticize some aspects and support others. Their judgement is usually realistic. The extension agent should take their views into careful consideration and attempt to remedy any defect.

\* \* \* \* \*

Further Reading:

Asian Productivity Organization Training Manual: Post Harvest Prevention of Waste and  
1974 Loss of Food Grains. Tokyo A.P. Org. 358 pp.

Howard, W.E. A Training Outline for Rat Control in Assignment Report, Municipal Health  
1969 Services in Lebanon (Rat Control). Annex III. Alexandria. EMRO/WHO.  
p.i-xxiv.

Howard, W.E. & Marsh, R.E. Rat Control Manual. Pest Control 42(8): p. D-U.  
1974

Pattinson, I. et al. Conférences sur les aspects économiques de l'entreposage des  
1973 grains. Institut de Technologie alimentaire, Sénégal. Rome. UNDP/FAO.  
AGS/SEN/64/505 Rapport interne No. 102.

ANNEX I

Observations on grain in faulty storage conditions and the probable damaging agent resulting in the symptoms observed

Criterion	Symptoms	Probable damaging agent
Appearance	<ol style="list-style-type: none"> <li>1. Dirty looking; blackish/greyish/greenish colour with lump formation</li> <li>2. Presence of whitish flour-like dust</li> <li>3. Holes in kernels</li> <li>4. Presence of insects, their eggs and larvae</li> <li>5. Presence of small black droppings/hairs</li> <li>6. Presence of whitish/greenish droppings</li> <li>7. Presence of tiny (1 mm. or less in length) creatures with soft bodies. They may be clinging to the sides of the storage structure or on the surface of grain or grain bags</li> <li>8. Sprouting</li> </ol>	<p>Micro-organisms</p> <p>Insects</p> <p>Rodents</p> <p>Birds</p> <p>Mites</p> <p>Moisture</p>
Physical texture	<ol style="list-style-type: none"> <li>9. Soft kernels</li> <li>10. Easily pulverizable kernels when pressed between fingers</li> </ol>	<p>Moisture</p> <p>Moisture or Insects</p>
Odour	<ol style="list-style-type: none"> <li>11. Musty, mouldy, disagreeable</li> <li>12. Urinary, repelling</li> </ol>	<p>Moisture and micro-organisms</p> <p>Rodents/birds</p>
Temperature	<ol style="list-style-type: none"> <li>13. High</li> </ol>	<p>Insects/moisture/micro-organisms</p>



### SAVE GRAIN CAMPAIGN

Extracts from a document issued by  
the Department of Food, Government of India

Farmers in India retain about 70 percent of the foodgrains produced for food, feed and seed. Only about 30 percent goes to the market for consumption in urban areas. Realising the huge losses which occur in storage at farm level, the Department of Food, Government of India, drew up a pilot project in the year 1965-66 under the title SAVE GRAIN CAMPAIGN. Farmers and managers of cooperatives, grain markets, etc. were approached and the techniques of insect pest, rodent and bird control demonstrated, as well as the scientific methods of storage. The response was very encouraging, especially from the farmers who were the worst hit.

A need was felt for imparting training and also undertaking applied research in grain storage. In 1968, therefore, with the help of FAO/UNDP, an Indian Grain Storage Institute was started under the Department of Food. The main emphasis was on i) training in scientific methods of storage to everyone concerned with storage of foodgrains, viz. farmers, traders, cooperative management, etc.; ii) development of suitable storage structures for use at farm level, and iii) extension of research results concerning pest control and storage techniques.

In 1969 the Government was approached to launch the SAVE GRAIN CAMPAIGN on a nation-wide scale. The idea was approved by the Planning Commission as well as the Department of Food, and regional Save Grain Campaign teams were established at Bombay, Patna, Ghaziabad, Bhopal, Hyderabad and Madras. Two research sub-stations at Ludhiana and Bapatla to undertake research on storage problems related to wheat and paddy respectively were also started. The Save Grain Centres are giving training to farmers in the regional languages; actually demonstrating methods of storage and stored grain insect pest control in the villages; and publishing extension literature in the regional languages, utilising all the valuable communication media such as radio, television, newspapers, etc.

#### Project Implementation

The programme of action under the project has been broadly divided into the following heads:

#### I. Through the Indian Grain Storage Institute:

- i) To organize and coordinate research programmes in the field of storage, pest control and storage engineering aspects.
- ii) To provide apex-level training for teachers of extension training centres, engineers and technicians concerned with the manufacture of storage structures, representatives of private pest control firms, etc.

II.. Through the State Governments:

- iii) To arrange manufacture of improved types of storage structure and supplying them to farmers on a credit basis.
- iv) To ensure the adoption of scientific techniques of storage and pest control in the State Government godowns (warehouses) and farms to serve as models to farmers, cooperatives, etc. and the propagation of the techniques to private dealers, and also step up the enforcement of safe storage and pest control measures made obligatory under the relevant licensing rules and public health laws.

III. Through the Save Grain Campaign Teams:

- v) Undertaking extensive training, demonstration and publicity programmes at state/block levels.
- vi) Assisting the extension training centres/home science colleges in propagation of scientific storage at the level of farm women.
- vii) Assisting the State Government as well as the licensee foodgrain dealers and millers, in the proper implementation of safe storage methods made obligatory under relevant licensing rules and orders.
- viii) Providing field level assistance to the Indian Grain Storage Institute and the State Governments in their respective programmes.

Training under the Save Grain Campaign is of two types - stipendiary and non-stipendiary. A stipend is being provided to the representatives of farmers, traders and cooperatives when they successfully complete the training course, which is of three weeks duration.

There are two categories of non-stipendiary training course:

- a) a week's duration to personnel of Block Development Office, State Food Departments, etc.;
- b) two to three days' duration for volunteers selected from different villages and grain markets. No tuition fee is being charged for any of these training courses.

Demonstration of disinfestation measures is given free of cost to farmers, traders, millers in their own godowns. Selected areas are being made pest free and maintained as such to serve as models to others.

Publicity is arranged through various media such as radio, television, talks, press advertisements, display of posters in public places, such as grain markets, railway stations and villages; supplies of hand out literature, film and slide shows, participation in village fairs and exhibitions, etc.

Assistance to extension training centres/home science colleges will be provided through grants-in-aid for appointing full-time women instructors for training farm women in improved rural/domestic storage techniques.

Technical assistance is being given to the State Governments and licensee-foodgrain dealers and millers to promote the implementation of the obligatory safe storage provisions applicable to licensees.