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A bibliography on post-harvest losses in cereals and pulses with particular reference to tropical and subtropical countries (G110)

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Tropical Products Institute

G110

A bibliography on post-harvest losses in cereals and pulses with particular reference to tropical and subtropical countries

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Ministry of Overseas Development

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This report was produced by the Tropical Products Institute, a British Government organisation which co-operates with developing countries in deriving greater benefit from their renewable resources. It specialises in post-harvest problems and will be pleased to answer requests for information and advice addressed to the Director.

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Introduction

Several excellent reviews on losses which occur during storage have been published in the last 10 to 15 years but very little has been written on losses which occur at *all* points in the post harvest system (from the mature crop in the field to the time of consumption). This bibliography encompasses the complete system for losses in cereals and pulses in an attempt to fill in some of the gaps but perhaps as important, it also shows where information is lacking. The list of references is by no means exhaustive and only includes those references which the author had to hand by the end of July 1976. An updating volume may be published when sufficient additional references have been collected.

In order to help the reader to locate appropriate references the material has been arranged in two ways. First information in the references has been tabulated and cross-referenced according to subject (Tables 1 to 6). Second, the references, which are listed alphabetically by author, have been grouped into three major categories according to the type of work described, i.e. reviews, experimental work and field estimates. Field estimates have been further subdivided into provisional estimates, supported estimates, and complete estimates.

The *reviews* (numbered R1—R60) are papers which, in some cases, merely requote loss estimates indexed under another author in order to demonstrate the importance of applying appropriate protection measures. In other cases they give a more detailed review of research into the methodology of post harvest loss assessment.

Experimental work (numbered E1—E79) includes work done either in the laboratory or as a small scale field trial, such as an investigation of specially constructed stores on a research site. In most cases the results of this research have not been applied by their investigators to situations occurring in normal practice. These references have been cross-referenced only according to commodity and cause (Table 1).

Field estimates are references concerned with estimates of loss and the methods used to obtain these in the field. They have been subdivided, according to the extent of information provided and the completeness of the investigation, into three categories:

1. *Provisional estimates* (numbered A1—A52) are those which consist entirely of an estimate of loss without any detailed description of the method by which it was obtained.
2. *Supported estimates* (numbered B1—B63) are those in which the estimate of loss is supported by details of the method by which it was obtained but has some components absent or not clearly documented.
3. *Complete estimates* (numbered C1—C11) are those which are fully documented and give the reader sufficient information on the methods employed to enable a decision to be made about the reliability of the estimate.

Tables 1 to 6, each arranged by commodity and cross-referenced by various factors, precede the lists of references. Review material has not been cross-referenced in the tables and experimental work is cross-referenced only by cause of loss, (Table 1).

Tables 1 to 5 only include references drawn from the three Field Estimates lists.

Table 2 subdivides the references by region. Only a few general estimates are included for Europe and North America for comparison with the tropical and sub-tropical estimates. Those references which contain methodologies suitable for use in other regions have also been included. West Africa is included as representative of the more humid region of Africa since there is minimal information from the Sahelian zone. The rest of Africa is included under East, Central and Southern Africa. Asia includes such areas as Indonesia and the Philippines which are important for their work on paddy and rice. No references have been included for Australia and none were available for any of the Pacific Islands.

In *Table 3* sub-division is by the *cause* of loss. Very few separate references to losses caused by mites were available and most microbiological losses were caused by fungi.

In *Table 4* sub-division is by *type* of loss. The distinction between types of loss is not sharply defined but quantity is regarded as any estimate expressed in terms of weight loss whereas quality mainly includes estimates of damage. Therefore many references appear under both sub-headings. In cases where there is doubt the estimate is listed as unspecified.

Table 5 is subdivided according to the level within the post harvest system at which the loss is measured. Trader/Cooperative is taken as the level above the farmer and does not extend into large scale commercial practice. Large scale includes both bag and bulk handling facilities.

In *Table 6* sub-division is according to the particular activity within the post harvest system during which the loss occurs. Harvesting is included since it is a post maturity loss and is not normally included within pre-harvest crop loss appraisal methodology. For convenience the major mechanical processes that occur between harvest and consumption are placed together, a glance at the title of the reference will distinguish the various processes.

It is fairly simple to trace a specific reference using the tables, for example: a loss estimate for *maize storage* at *farm level* in *East Africa* can be found by listing all the maize references for East Africa in table 2 and checking for maize under farm in Table 5 and storage in Table 6 to eliminate unwanted references.

Where a pulse has not been given a generic name by the author and it is not obvious from its common name into which category it falls, it has been placed under PULSES: General, e.g. beans may not always be *Phaseolus* spp.

Table 1

Experimental work: cause of loss cross-referenced by commodity

Cause Commodity	Biological factors			Physical factors	
	Insects and Mites	Vertebrates	Micro-biological	Handling	Environmental
CEREALS					
General	E35, E37, E39, E69	E40, E49			
Maize	E1, E8, E14, E24, E27, E29, E31, E44, E45, E46, E51, E58, E59, E60, E78		E46, E47, E48	E13, E63	E71
Paddy/rice	E8, E29, E31, E44, E54		E50		E53, E62, E79
Sorghum/millet	E29, E39, E44, E74, E75, E78	E9	E39		
Wheat	E5, E6, E7, E10, E11, E15, E16, E20, E21, E22, E23, E29, E31, E32, E42, E43, E44, E56, E60, E65, E66, E67, E68, E70, E76, E78			E13, E32	E79
Others	E11, E29, E44				
PULSES					
General	E3, E12, E33, E34, E35, E36, E37, E39	E9, E40, E49			E3, E41
<i>Vigna</i> spp.	E4, E14, E26, E30, E57, E58, E59				
<i>Phaseolus</i> spp.	E2, E14, E26, E30, E55, E57, E61, E72, E77				
<i>Cicer</i> spp.	E2, E26, E52, E55, E57, E61, E64, E77				E79
Other pulses	E25, E30, E35, E52, E57, E64, E72, E77				
Groundnuts	E18, E19		E17		E79
Other Oilseeds	E28, E30				E79

Table 2

Field estimates: geographical region cross-referenced by commodity

Commodity	Geographical region	Americas		Africa		Asia, including Far East	
	Europe	Central and South and West Indies	North	West	East, Central and Southern	Indian subcontinent	Elsewhere
CEREALS							
General	A22		A29, B4, B56	A38, C2	A36, A44, B13	A19, A22, A34, B6, B25, B45, B52, B55	
Maize		A32	A10, A14, A48, B12, B22, B31, B58, C4	A7, A11, A39, A41, B2, B3, B38, B39, B54	A6, A28, A31, A51, B3, B16, B18, B20, B28, B36, B42, B43, B49, B60, C1, C8, C9	A20, A34	
Paddy/rice		A25	A48, A49, B57	A11, A43, A47, B30	A31, A43, B33, B42	A15, A20, A21, A26, A34, A52, B8, B37, B40, B41, B51, B61, C10	A2, A21, A27, A52, B32, B50
Sorghum/millet			A48, B59	A1, A11, A43, B24, C3	A6, A31, A42, B43	A20, A24, A34, B44	
Wheat	B14		A48, C4, C11		A44, B1	A17, A20, A26, A34, B23, B26, B27, B35, B46, B47, B52, B62, B63	
Others	B34		A48, C11			A24, A34	
PULSES							
General				A41, A43, B54	B13, B17, B19	A20, A24, A28, B52	
<i>Vigna</i> sp. (Cowpeas etc)		A4		A1, A8, A16, A42, B10, B11	A31		
<i>Phaseolus</i> sp. (Beans etc.)					A31	A41	
<i>Cicer</i> sp. (Grams)						A5, A35, B46	
Other pulses						A5, A35, B48, C6, C7	
Groundnuts		A3		A38, A46, B15, B29, C5	A31		
Other oilseeds			B31, C4, C11			A35	
GENERAL	A23, A45		A18		A51	A30	

Table 3

Field estimates: cause of loss cross-referenced by commodity

Cause Commodity	Biological factors			Physical factors
	Insects and mites	Vertebrate	Microbiological	Handling
CEREALS				
General	A4, A19, A30, A34, A37, B6, B13, B25, B45, B52, C2	A4, A19	A4, A51, B25	A19, B4, B55
Maize	A4, A6, A14, A20, A28, A34, A39, A41, A51, B2, B3, B9, B16, B18, B20, B22, B28, B36, B38, B39, B42, B43, B49, B54, B60, C1, C8, C9	A20, A24, A51, C1	A7, A20, A32, B2, C1	B12, B31, B58, C4, C11
Paddy/rice	A2, A4, A9, A15, A20, A25, A26, A27, A34, A43, A49, B8, B30, B33, B40, B42, B51, B57	A2, A13, A20, A24, A52, B30, B37, B40, C10	A2, A15, A20, B40	A15, A21, A52, B32, B41, B50, B61
Sorghum/millet	A1, A6, A20, A34, A43, B24, B42, B44, C3	A20, A24	A20	B59
Wheat	A17, A20, A26, A34, A44, B1, B14, B26, B27, B35, B46, B47, B52, B62, B63	A12, A17, A20, A24, B7, B23, B26, B37	A20, B26	C4, C11
Others	A34	B34, B37		C11
PULSES				
General	A20, A28, A30, A34, A41, A43, B13, B17, B19, B53, B54	A20, A24, B37	A20	
<i>Vigna</i> spp.	A1, A4, A8, A16, A42, B10, B11			
<i>Phaseolus</i> spp.	A40			
<i>Cicer</i> spp.	A34, B46			
Other pulses	A5, A34, B48			C6, C7
Groundnuts	A3, A38, A46, B15, B21, B29, C5		A3, A38	
Other oilseeds	A35			B31, C4, C11
GENERAL	A22, A23, A30, B5, B56	A12, B5	B5	A30, B5

Table 4

Field estimates: type of loss cross-referenced by commodity

<i>Commodity</i>	<i>Type of loss</i>	<i>Quantity</i>	<i>Quality</i>	<i>Nutrition</i>	<i>Germination</i>	<i>Unspecified</i>
CEREALS						
General		A10, A12, A19, A44, A51, B13, B52, B55, C2	A12, A29, A37, B4, B6, B25, B45		A34, B25, B45	A33
Maize		A6, A10, A11, A14, A24, A28, A48, A51, B2, B3, B9, B16, B18, B20, B28, B36, B38, B39, B42, B43, B49, B54, B58, B60, C1, C4, C8, C9, C11	A6, A7, A14, A32, A39, A48, B12, B22, B31, B42, C1, C8, C9	A20, A26, B22	A34, B3, C1	A31, A41
Paddy/rice		A2, A9, A11, A13, A15, A21, A24, A26, A43, A47, A48, A52, B8, B30, B32, B33, B37, B40, B41, B42, B50, B51, B61, C10	A9, A15, A34, A48, A52, B8, B40, B41, B42	A11, A20, A26, B57	A34, A47	A25, A27, A31, A49
Sorghum/millet		A6, A11, A24, A43, A48, B24, B42, B59, C3	A6, A34, A48, B42, B44	A20	A34, B44	A1, A31
Wheat		A12, A17, A24, A26, A44, A48, B1, B7, B23, B26, B27, B35, B37, B46, B47, B52, B63, C4, C11	A12, A17, A30, A34, A48, B14, B26, B27, B47, B52, B62	A20, A26	A34, B26, B46, B47	
Others		A24, A28, A48, B34, B37, C4, C11	A34, A48		A34	
PULSES						
General		A24, A43, B13, B17, B19, B37, B52, B54	A35	A20, A26		A41
<i>Vigna</i> spp.		A16, A42, B10, B11	A4, A8			A1, A31
<i>Phaseolus</i> spp.						A31, A40
<i>Cicer</i> spp.		B46	A35		B46	
Other pulses		A5, B48, C6, C7	A35, C6, C7			
Groundnuts		A3, A43, A46, B15, B21, B29, C5	A3, A38, A46, B15, B21, B29, C5			A31
Other oilseeds		C4, C11	A35, B31			
GENERAL		A30, B5	A30, A45	B56		A18, A22, A23

Table 5

Field estimates: level within post harvest system cross-referenced by commodity

<i>Commodity</i>	<i>Level</i>	<i>Farm</i>	<i>Trader/Cooperative</i>	<i>Large Scale</i>	<i>Unspecified</i>
CEREALS					
General		A33, A36, B6, B25, C2	B25, B45, B52	A29, B4, B13, B55	A22, A34
Maize		A11, A14, A28, A39, A51, B2, B3, B16, B18, B20, B22, B28, B36, B39, B42, B54, B58, B60, C1, C8, C9	C11	A6, B12, B31, B43, B49, C4, C11	A7, A10, A20, A24, A31, A32, A34, A41, A48, B9, B38
Paddy/rice		A11, A15, A21, A47, B8, B32, B37, B40, B41, B42, B50		A13, B30, B57, B61, C10	A2, A9, A20, A24, A25, A26, A27, A31, A34, A43, A48, A49, A52, B33, B51
Sorghum/millet		A1, B24, B42, B44, B59, C3		A6	A20, A24, A31, A34, A43, A48
Wheat		A17, B14, B23, B27, B35, B37, B47, B53, B62, B63	B26, C11	A12, B1, C4, C11	A20, A24, A26, A34, A44, A48, B7, B46
Others		B34, B37	C11	C11	A34, A48
PULSES					
General		A28, B37, B54			A20, A24, A35, A41, A43, B17, B19
<i>Vigna</i> spp.		A1, A16	A4, A42, B10, B11, B52	B13	A8, A31
<i>Phaseolus</i> spp.		A40			A31
<i>Cicer</i> spp.					A35, B46
Other pulses		A5	B48	C6, C7	A35
Groundnuts		B29	A46	A3, B15, C5	A31, A38, B21
Other oilseeds			C11	B31, C4, C11	A35
GENERAL		A30, A51	A30	A12, A30	A18, A19, A23, A38, A45, B5, B56

Table 6

Field estimates: activity in post-harvest system cross-referenced by commodity

Commodity \ Activity	Harvesting	Threshing, drying, handling, processing	Storage	Transport
CEREALS				
General		A29, B4	A10, A19, A22, A33, A34, A36, A37, B6, B13, B25, B45, B52, C2	B55
Maize	B58	A20, B12, B31, B58, C11	A6, A7, A10, A11, A14, A20, A24, A28, A31, A32, A34, A39, A41, A43, A48, A51, B2, B3, B9, B16, B18, B20, B22, B28, B36, B38, B39, B42, B43, B49, B54, B60, C1, C8, C9	C4, C11
Paddy/rice	A15, A21, A52, B32, B41, B50	A15, A20, A21, A52, B41, B50	A2, A9, A11, A13, A15, A20, A24, A25, A26, A27, A31, A34, A43, A47, A48, A49, A52, B8, B30, B33, B37, B40, B42, B51, B57, B61, C10	A52
Sorghum/millet	B59	A20	A1, A6, A11, A20, A24, A31, A34, A43, A48, B24, B42, B44, C3	
Wheat		A20, B23, C11	A12, A17, A20, A24, A26, A34, A44, A48, B1, B7, B14, B26, B27, B35, B37, B46, B47, B53, B62, B63	C4, C11
Others		C11	A24, A34, A48, A34, B37	C11
PULSES				
General			A20, A24, A28, A35, A41, A43, B13, B17, B19, B37, B52, B54	
<i>Vigna</i> spp.			A1, A4, A8, A16, A31, A42, B10, B11	
<i>Phaseolus</i> spp.			A31, A40	
<i>Cicer</i> spp.			A35, B46	
Other pulses		C6, C7	A5, A35	B48
Groundnuts			A3, A31, A46, B15, B21, B29, C5	
Other oilseeds		B31, C11	A35	C4, C11
GENERAL	A30	A19, A30	A12, A19, A23, A30, A37, A51, B5, B56	A19, A30.

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