JRC Scientific and Technical Reports

The African Postharvest Losses Information System (APHLIS)

An innovative framework to analyse and compute quantitative postharvest losses for cereals under different farming and environmental conditions in East and Southern Africa

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EUR 24712 EN - 2011

EUROPEAN COMMISSION JRC
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University of Greenwich Natural Resources Institute
Bundesanstalt für Landwirtschaft und Ernährung
ISICAD.org
Southern African Development Community
ASARECA Transforming Agriculture for Improved Livelihoods
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European Commission
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JRC 62618

EUR 24712 EN
ISBN 978-92-79-19143-5
ISSN 1018-5593
doi: 10.2788/40345

Luxembourg: Publications Office of the European Union

Cover photo: traditional Namibian grain stores made from mopane wood (courtesy of Rick Hodges)

Printed in Luxembourg

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Foreword

The assessment of cereal supply is a key component of early warning for food insecurity in developing countries and food (un)availability remains the main trigger of famine in drought prone regions.

Food Balance Sheets are produced each year after harvest, to estimate the need for food importation, to anticipate food security crisises and possibly call for international assistance. They also provide data on which to base decisions about possible local purchase or the export of surpluses.

Food Balance Sheets have to take into account grain production, the available stocks from previous year, the non-food uses, the import and exports, but also the Postharvest Losses (PHLs). These losses occur at time of harvest, though various postharvest operations on farm to the first level of market. However, PHLs have been considered as a second priority for more than 20 years, so that the figures used in calculations are highly variable and often poorly documented.

A complete literature review, that preceded the setup of the APHLIS system showed that PHL figures are highly variable (from 5 up to 30% or more) and differ between cereals, according to the postharvest technologies employed. They are also very sensitive to a number of factors: meteorological conditions at harvest, presence of pests (such as larger grain borer) and duration of storage at farm level.

The APHLIS system, resulting from a very efficient collaboration between European institutions and African regional network of experts, provides an innovative framework to analyse and compute quantitative PHLs under different farming and environmental conditions in East and Southern Africa.

Besides providing a more transparent calculation of Food Balance Sheets, this system offers significant advantages for the future. Several opportunities are presently under discussion with the World Bank and the FAO, including -

- The geographic extension of APHLIS to include the whole of subSaharan Africa;
- A detailed analysis and verification of the estimates provided by the system including the analysis of extreme values;
- The preparation and documentation of a standardised methodology for the collection of PHL data, to ensure that more data become available and are compliant with common quality standards;
- The collection of more PHL data, using the standardised methodology that will increase confidence in PHL estimates and will guide loss reduction strategies to increase food security.

Dr. Hanns-Christoph Eiden
Präsident der Bundesanstalt für
Landwirtschaft und Ernährung

Summary

The present report by the Joint Research Centre (MARS Unit - FoodSec action) is the result of 2 studies launched by the JRC in the frame of its scientific support to the European Food Security Thematic program, and carried out in 2008-2010 by a consortium of European and African partners:

- NRI (Natural Resources Institute, UK)
- ISICAD (Information Systems for International Cooperation in Agricultural Research and Rural Development) of BLE (German Federal Office for Agriculture and Food),
- ASARECA (Association for Strengthening Agricultural Research in Eastern and Central Africa)
- and SADC (Southern African Development Community).of the European Commission's.

The implementation of the Postharvest Losses (PHL) studies have been supervised by a JRC steering committee involving UN Food And Agriculture Organisation (FAO), World Food Program (WFP), and Directorate General AIDCO.

The overall objective of these studies was to develop an information system capable of generating figures for the quantitative PHLs of cereal grains in a scientific and transparent way, taking advantage of all available information and enabling regular updating of PHL estimates as new data become available. The main activities of the studies were to

1) Review the postharvest literature to located PHL estimates;
2) Establish a network of local experts to gather key data and validate loss estimates;
3) Formulate a framework questionnaire to structure data gathered by local experts;
4) Develop a web-based database and information system to hold and access key data;
5) Create a model for the estimation of PHLs that connects to the database.

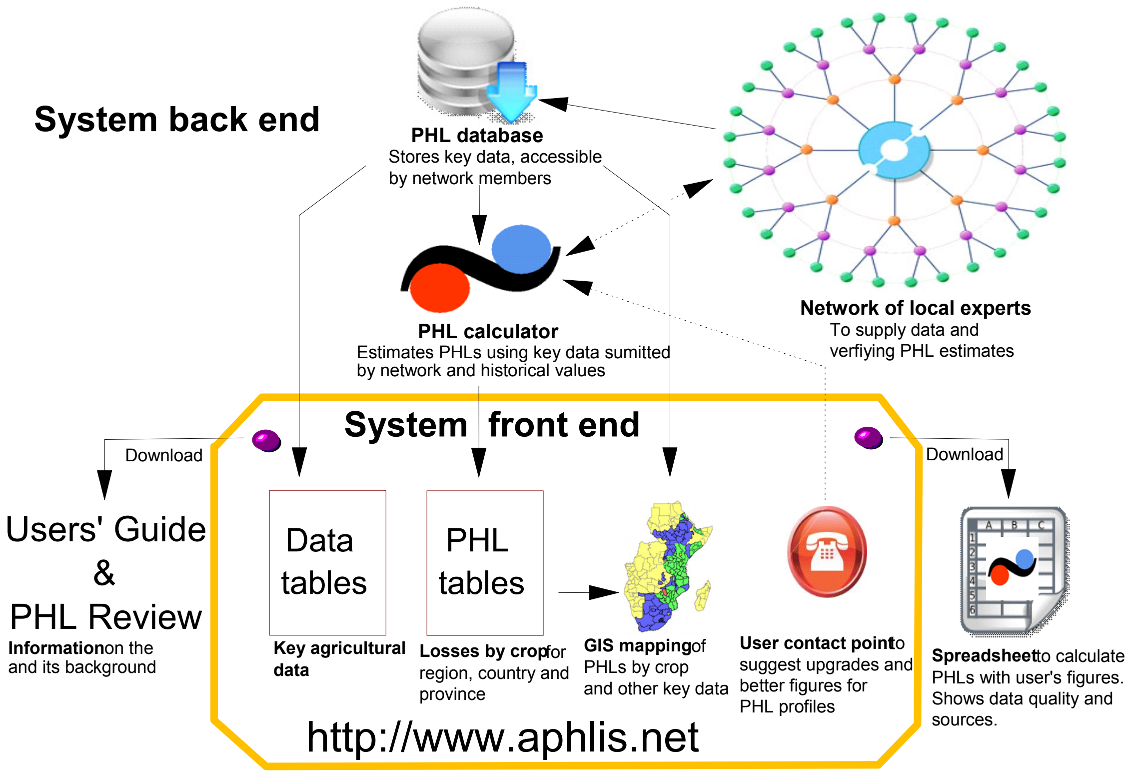
In the early stages of the project the available PHL data were collected from published literature and standardised for use in the database. Most of these data relate to storage losses with only a little covering other aspects. Subsequently, only small amounts of additional data have been found and although some further loss figures may be submitted by the PHL network, not much reliable, well documented data are expected.

In order to share these data between similar provinces, a clustering process was undertaken based around climate classification; provinces were broadly clustered according to whether they had tropical, arid or temperate climates. For each crop, those provinces in the same cluster would share their loss data. In this way, a relatively small amount of PHL data were used to represent a wide geographical area. For each cluster and each crop a loss profile was defined which holds all the loss estimates from each relevant link in the postharvest chain. A losses model adjusts the cumulative loss estimate for a given loss profile according to factors such as

- the proportion of small-scale and large-scale (commercial) farms,
- the number of harvest per annum
- the amount of crop that is marketed directly,
- whether or not maize is subject to serious infestation by the larger grain borer, and
- if provinces have damp/cloudy weather at time of harvest(s).

The resulting Information System, called the **African Postharvest Losses Information System (APHLIS)**, is available on the web at http://www.aphlis.net. Its main elements are shown in the following diagram.

The APHLIS Information System at a glance



The front end to the information system has been designed to display PHL estimates for particular crops by country and by province and is capable of taking into account local factors that may affect the magnitude of loss.

From the website users can access and query PHLs for particular crops, place and year, download a Users' Guide and a Review Paper on the weight losses of cereals in Eastern and Southern Africa. A stand alone PHL calculator (version of the PHL model in an Excel spreadsheet) can be also downloaded by user to be used in field surveys. Default values can be replaced with user-specific values and estimates made of PHLs at any appropriate geographical scale. The spreadsheet also displays a rating of the quality of the data for each element of the PHL profile used in the estimation and provides references to the original data sources.

Participants in the PHL network can upgrade the database by submitting improved losses data and other agricultural statistics by access to the back end of the website. The tables of these statistics can be viewed by the user. Users are encouraged to submit new data on measured estimates of losses, from any link in the postharvest chain, so that these can be entered into the database to upgrade the PHL profiles used by the model to estimate PHLs.

APHLIS milestones

- The first PHL study was launched in February 2008 at a kick off meeting in Ispra, followed by a visit to Rome to gather background information on PHLs. Meetings were held with FAO's Global Information and Early Warning System (GIEWS) and the WFP to present the needs of the project and the opportunities it may offer.
- The 1st progress meeting was held in May 2008 in the UK to include African partners from the regional organisations (ASARECA and SADC - FANR), review the progress and prepare a regional workshop for the network the experts in Africa.
- The 1st regional workshop was held in South Africa at the end of June 2009: Participants were successfully inducted into the PHL network and contributed to the definition of the framework questionnaire and procedure to collect key data for the PHL database. Agreements on submission of data and deadlines were successfully defined so that by February 2009, 94 % of countries represented at the South Africa workshop had completed data entry.
- The 2nd progress meeting, held in September 2008 in FAO Rome, allowed agreement on the main concepts /components of the system. During this meeting, GIEWS made a presentation on the calculation of their own PHL figures and, as a key user of the future system, expressed strong support for the approach being taken by the PHL project.
- A 2nd regional workshop was held at ASARECA (Entebbe) in December 2008, with a strong representation from the Horn of Africa. It was designed to seek local expert endorsement on the province clustering process, the processing of data, the model for estimating PHLs, and the definition of the database front-end.
- The African Postharvest Losses Information System (APHLIS) went live on the web in January 2009 and is available at http://www.aphlis.net.
- The Final meeting and user training workshop was held in Bonn in February 2009 to present the functioning PHL estimation system and offer practice in it use.
- During the second half of 2009 a small follow up study was launched by JRC with the main objectives of: i) Seeking to make the system autonomous and sustainable by better complementary dissemination/awareness raising with other organisations and ii) Underpinning further data collection and strengthening/extending the present network.
- In 2010 significant improvements were made to the APHLIS website allowing users to see the full calculation of postharvest losses including a rating of the data sources. This enables APHLIS network members to check the data they have supplied and where necessary seek improvements.
- A final workshop was held in Bonn in August 2010 to consider how APHLIS can be both developed further and be made sustainable in the long term. This was attended by a range of participants including from FAO and WFP, other users of the system and potential new West African stakeholders.
- For improving the supply of postharvest loss data to APHLIS a proposal was developed for a manual on postharvest loss assessment and two scientific publications prepared describing APHLIS. These will act as reference points for its further development.
- A close coordination has been established with the World Bank, FAO and NRI study "Missing Food: The case of postharvest grain losses in Sub-Saharan Africa" and concepts have been developed together on how to include Western African countries within APHLIS.

Acronyms and abbreviations

AfDB	African Development Bank
APHLIS	African Postharvest Losses Information System
ASARECA	Association for Strengthening Agricultural Research in Eastern and Central Africa
BLE	German Federal Office for Agriculture and Food
CFSAMs	Crop and Food Supply Assessment Missions
CTA	Technical Centre for Agricultural and Rural Co-operation ACP-EU
FAO	United Nations Food and Agriculture Organisation
GIEWS	Global Information and Early Warning System (of FAO)
INPhO	Information Network on Postharvest Operations
ISICAD	Information Systems for International Cooperation in Agricultural Research and Rural Development (of BLE)
JRC	Joint Research Centre (of the European Commission)
LGB	Larger Grain Borer (*Prostephanus truncatus*)
MARS	Monitoring Agricultural Resources (Unit of JRC)
NRI	Natural Resources Institute
PhAction	Postharvest Action (Global Postharvest Forum formerly GASGA)
PFL	Prevention of Food Losses Programme
PHL	Postharvest loss
SADC	Southern Africa Development Community
WFP	United Nations World Food Programme
WRS	Warehouse Receipt System

1. Introduction

Soaring food prices in 2006/08 and the risk of food shortages in the future have renewed interest in agricultural development in Sub-Saharan Africa (SSA). For the majority of the population of SSA, cereal grains are the basis for food security and a vital component in the livelihoods of smallholder farmers. Cereals constitute about 55% of the African food basket and for every 1% increase in food prices, food expenditure in developing countries decreases by 0.75% (FAO, 2006). In seeking to make improvements to cereal grain supply, an important element to consider is postharvest losses (PHLs) and major donors have recently been focusing on loss reduction strategies (FAO/AfDB, 2009; World Bank, 2010). The grain storage community has had a long standing interest in the assessment and reduction of PHLs, especially since the food crisis of the 1970s. Estimates of PHLs became both a justification, and an objective measure, for the subsequent Prevention of Food Losses (PFL) programme led by FAO (UN Food and Agriculture Organisation). The PFL programme continued into the 1990s but drew to a close as food prices return to their long term downward trend.

Grain postharvest losses may be both the physical losses (weight and quality) suffered during postharvest handling operations and also the loss of opportunity as a result of producers being unable to access markets or only lower value markets due to, for example, sub-standard quality grain or inadequate market information. Investment in reducing physical PHLs is an attractive option since grain supply can be increased without wasting other resources such as labour, water, land, and agricultural inputs. Wide ranging reviews of grain postharvest losses have been published by Greeley (1982), Boxall (1986), Grolleaud (1997) and Boxall (2001).

Reliable estimates for postharvest weight losses are needed for at least three purposes: planning and prioritizing loss reduction programmes, guiding the development of agricultural policy, and for the calculation of cereal supply/demand balances of developing countries. In the case of cereal supply balances, an estimate of how much grain may be available to consumers emerges when national cereal production/import figures are corrected for postharvest losses. Examples of cereal supply calculations can be seen in the Crop and Food Supply Assessment Missions (CFSAMs) on the website of FAO's Global Information and Early Warning System (GIEWS[1]).

This report explains the construction and operation of APHLIS (The African Postharvest Losses Information System), a recent development in PHL estimation that provides the countries of East and Southern Africa with cereal PHL figures. These are estimated by crop, by country and by province and take into account scale of farming, climate type, number of harvests, proportion marketed etc. (Hodges et al., 2010). APHLIS was developed initially to support cereal supply calculations but may be equally useful to the other applications of PHLs estimates.

The momentum of the project and the contribution and participation of partners was achieved through a series of meetings implemented between February 2008 and February 2009. During the second half of 2009 and in 2010 the APHLIS system was then systematically presented at international conferences and meetings.

[1] http://www.fao.org/GIEWS/english/alert/index.htm

2. Project achievements and outputs

2.1. Literature and information on PH losses

2.1.1. Progress on the collection of historical PH losses data

Prior to commencing this study 22 reports on PH losses were readily to hand (although not necessarily containing useable data) and after searching and screening the current full list of documents, now 75, includes those on more general issues of post harvest losses. The PH literature consulted and the information it contained is now a component of the PHL database where is can be viewed directly or is referenced in relation to the figures used for loss estimations. This referencing system also includes an evaluation of the quality of the data source.

At the time that the 1st progress report was delivered it was clear that there would be a continuing but only small stream of relevant reports, boosted by grey literature when the PHL network became operational. However, it was considered that this would be unlikely to yield much in the way of reliably-measured loss data and this has been the case. Of the weight losses estimates available for countries in East and Southern Africa, the most numerous are for storage (Table 1), there many figures for maize and sorghum but few for other crops and there are no measured figures for rice storage losses. There are very few studies for other parts of the post harvest chain (Table 2).

Table 1 – Numbers of storage weight loss estimates that have been found for various grains and their condition in East and Southern Africa and the numbers of different provinces to which these figures apply

Grain and its condition	No. of storage loss estimates	No. different provinces
Maize cobs with LGB infestation	12	4
Maize cobs no LGB infestation	21	9
Maize grain with LGB infestation	2	2
Maize grain no LGB infestation	8	4
Sorghum unthreshed	1	1
Sorghum threshed	15	10
Millet - threshed	2	1
Wheat - threshed	6	2
Barley - threshed	2	1
Rice	3	3
Teff	1	1
Total	**73**	**38**

Table 2 – Total number of post harvest loss estimates for East and Southern Africa from various points in the post harvest chain (excluding storage losses)

Harvesting and drying losses		Total no. studies	Cereals generally	Maize	Millet	Sorghum	Rice
Field drying	Small-scale farming	10	2	5	1	1	1
	Large scale farming	3	1	2	0	0	0
Platform drying	Small-scale farming	2	0	2	0	0	0
	Large scale farming	1	0	1	0	0	0
Threshing/shelling loss							
	Small-scale farming	5	2	2	0	0	1
	Large scale farming	2	1	1	0	0	0
Winnowing loss							
	Small-scale farming	2	1	0	0	0	1
	Large scale farming	0	0	0	0	0	0
Transport to store loss							
	Small-scale farming	4	2	1	0	0	1
	Large scale farming	1	1	0	0	0	0
Transport to market loss							
	Small-scale farming	1	0	1	0	0	0
	Large scale farming	0	0	0	0	0	0

There are still some documents that have not been located and might yield useful information, these are listed in Table 3.

Table 3: Losses studies for which we are still searching

Ethiopia

Kidane, Y. and Habteyes Y. (1989) Food grain losses in traditional storage facilities in three areas of Ethiopia. In: Proceedings of 'Towards a food and nutrition strategy for Ethiopia'. Alemaya University of Agriculture, 8-12 December 1986, Alemaya, Ethiopia. (Quoted in Boxall 1998)

Kidane, Y and Habteyes Y. (1986) Food grain losses in traditional storage facilities in selected areas of Ethiopia. Addis Ababa, December 1986. (Quoted in Boxall 1998)

SSEAD Consultancy (1997) Amhara national Regional State, Bureau of Agriculture, Regional Crop Pest Survey Report on Insect Pests. Addis Ababa (quoted in detail in Boxall 1998)

McFarlane J.A. (1969) A study of the storage losses and allied problems in Ethiopia. Report of the Tropical Products Institute. Pp.67. (Quoted in Boxall 1998)

Lesotho

Mofubetsoana, L.S. (1988) Review of grain (maize and sorghum) handling, storage and marketing in Lesotho. Not published.

2.1.2. Loss values for various links of the PH chain (excluding storage)

The actual values for the losses incurred in the non-storage parts of the PH chain are shown in Table 4.

Table 4: % weight loss figures for different activities in the postharvest chain, from various East/Southern African countries

Country	Ethiopia	Ethiopia	Swaziland	Zambia	Zimbabwe	Zimbabwe	Uganda	Uganda	Uganda	Madagascar
Data source	1	2	3	4	5	6	7	7	7	8
Data quality	Questionnaire survey - multiple sources	Questionnaire survey	Measured	Old measured data and data from outside Zambia	Commonly applied figures, origin ?	Questionnaire survey	Measured ?	Measured ?	Measured ?	Measured
Harvesting and drying	Cereals	Cereals	Maize	Maize	Maize	Maize	Maize	Sorghum	Millet	Rice
Field drying Small-scale	2	5	16.6[R]	13.5[p]	9.5	5.8	17.4[T]	11.3[T]	12.2[T]	6.85
Large scale	2	-	16.6[R]	13.5[p]						
Platform drying Small-scale	-	-	-	3.5	4.5	-	-	-	-	-
Large scale	-	-	-	3.5	-	-	-	-	-	-
Threshing/shelling										
Small-scale	1	6	-	-	1	2.5	-			6.5
Large scale	1	-	-	-	3.5	-	-	-	-	-
Winnowing										
Small-scale	0	5	-	-	-	-	-	-	-	2.5
Large scale	0	-	-	-	-	-	-	-	-	-
Transport to store										
Small-scale	2	3	-	-	1	-	-			2.25
Large scale	2	-	-	-	-	-	-	-	-	-
Transport to market										
Small-scale	-	-	-	-	1	-	-	-	-	-
Large scale	-	-	-	-	-	-	-	-	-	-

[R]rain at harvest [p]includes production losses? [T]includes threshing

Data sources

1. Boxall 1998
2. Vervroegen and Yehwola 1990
3. De Lima 1982
4. Lars-Ove Jonsson and Kashweka 1987
5. Odogola and Henriksson 1991
6. Mvumi et al. 1995
7. Silim et al. 1991
8. Repoblika Malagasy (1987)

Harvesting and drying
Of special interest is the harvesting/drying loss of 16.6% for Swaziland (Table 1). This was measured for two seasons when maize was harvested under damp conditions. These losses indicate what might be expected when climatic variations in the future lead to crops being harvested in unfavourably wet weather. More typical harvesting/drying losses are shown by the two figures from Zimbabwe 9.5% and 5.8% (Table 4). The only figure found for harvesting/drying losses of African rice is 6.9% and is from Madagascar. This is rather high compared to Asian losses which for China are 4.3% (IDRC, 1989), several Asian countries combined 4.0% (Calverley, 1996) and Bangladesh 1.95% (Huq and Greeley, 1980). The figures for harvesting and drying of sorghum and millet (11.3% and 12.2% respectively) appear also to include threshing losses. Platform drying, which raises the maize off the ground for longer-term drying, has been associated with losses 3.5% (Zambia) and 4.5% (Zimbabwe).

Threshing and shelling
There are two threshing/shelling loss figures for maize, both from Zimbabwe. For small-scale farming the losses are low, 1-2.5%, which might be expected since the process is usually by hand and may be contained within jute bags so there is little spillage, whereas the large scale figure is 3.5% and may reflect the greater spillage associated with mechanical shelling. The available data, attributes rather higher threshing losses to rice, a 6.5% measured estimate from Madagascar and 6% from questionnaire survey for cereals generally in Ethiopia.

Winnowing
Winnowing losses are relevant to most grains except maize. There are virtually no loss figures available. Winnowing losses of rice in Madagascar were measured at 2.5% while questionnaire survey results relating to cereals in Ethiopia average 5%.

Transport
Losses incurred from transport from field to store are little known and are likely to be highly variable. For rice in Madagascar they have been measured at 2.25% whereas ‘commonly applied’ figures or those from questionnaire surveys for other cereals range from 1% to 3%. There is at least some consensus on the general magnitude. For transport to market there is only a single ‘commonly applied’ figures offered, 1% for maize (Table 4).

2.1.3. Standardisation of storage loss data

If storage loss figures are either to be combined, so that they can be used to estimate the losses suffered by future harvests, or to be compared then they must be standardised. The original loss studies will have been undertaken over different time periods and may or may not have taken household consumption into account. Where necessary, for the purpose of this study, loss figures from the literature have been adjusted to a 9-month storage period and also adjusted for household consumption, assuming that the grain was consumed at an even rate over 9 months. The storage period was adjusted by considering the shape of the curve of loss over time that is suggested by the results of the original study and then by extrapolating or interpolating to infer the loss at 9 months. Alternatively, if there is insufficient data to suggest a loss curve then it would be assumed that by three months, six months and after nine months or more there would be 15%, 30% and 55% of the storage loss. In any case, the majority of storage studies are about 9 months, this is the length of a typical storage season. The resulting 75 adjusted, loss figures are presented in Annex 6 together with an indication of the original weight loss figure and type of source of the data. The best quality is considered to be measured estimates using modern methods, other methods such as questionnaire surveys or guesstimates would generally be less reliable although the measured estimates may not be much better than other approaches when they are being applied to much wider circumstances than those for which they are derived.

2.1.4. Derivation of loss figures in use in selected FAO CFSAM reports

PHL figures are used in the food supply calculations of FAO's Crop and Food Supply Assessment Mission reports that available on the GIEWS web site (http://www.fao.org/giews/english/alert/index.htm). The loss figures are quoted in two forms, either direct losses of the grain themselves or 'Other uses' which bundle together PHLs and the use of grain for feed, seed and sometimes also for brewing. An extensive list of figures was presented in the 1st progress report but without any detailed consideration of the basis to their calculation. In order to provide more information on this subject, recent loss estimates that had been used for seven different countries were selected and a request placed with GIEWS to help provide information about them in addition to what is already recorded in the CFSAM reports. The responses from GIEWS were presented in the 2nd progress report. It is clear that loss estimates in CFSAM reports

1) are based on very little documentary evidence. Two documents were quoted specifically - FAO 1977, Analysis of an FAO survey of post-harvest crop losses in developing countries, and National Academy of Sciences 1978, Postharvest Food Losses in Developing Countries. The figures in the later document largely quote the earlier one and it is stated that "the data is markedly inadequate" and quotes the FAO report as saying "the estimates for losses of durable commodities and the methods by which they are derived were inadequately refined".

2) are based on interaction between the Mission team and local experts. In particular they are founded on ideas relating to the current situation, personal experience and consensus with local experts.

3) can not necessarily be easily broken down into their component parts, e.g. those parts that are storage losses and those that are derive from other sources. There is a suggestion that at least in some case the PHL figures quoted are actually estimates for storage losses.

These observations confirm that the objectives of the current project, to provide a transparent means of providing PHL estimates and one that can be upgraded with improved data, are justified.

2.1.5. Collection and analysis of agricultural and climate data

The framework questionnaire has been used to collect agricultural and climatic data. This data is collected for two main purposes, either to enable provinces to be compared in relation to factors that may have a bearing on losses, or to actually facilitate the estimation of losses. This division is shown in Table 5, although in a few cases data will be used for both purposes.

Table 5: The end uses for data on agriculture and climate that are being collected in the framework questionnaire

Comparison of provinces	Making loss estimations
What crops are grown in the province	Presence of larger grain borer (LGB)
Average farm size	Proportion marketed directly after harvest
Average seasonal grain production and harvest period	Harvesting losses
Population	Drying losses
Rainfall: Total monthly rainfall	Threshing losses
Number of days with rainfall	Storage losses
Average maximum daily temperature	Storage duration
Average minimum daily temperature	
Total monthly rainfall	
Risk of flooding	
Store type	
Extreme climatic events – rain at harvest/flooding	

It had been hoped that it would be possible to collect some information on the extent to which PHLs are increased by extreme climatic event, particularly rain at time of harvest and flooding. Only a single loss study deals directly with wet conditions at time of harvest, this was for maize in Swaziland. An additional effort was made to associate flooding with PHLs by making a direct approach to those countries where CFSAM reports have quoted loss figures associated with floods climate. The countries approached were Sudan, Uganda and Mozambique. In addition Swaziland was approached in an attempt to gain an update on the losses that may occur due to rain at harvest, documents by De Lima in 1981/82. Unfortunately, in all these cases no further data were available.

Sudan - quite extensive flooding in 2007 which was detailed in the CFSAM report of January 2008. The following requests for information have been made

Uganda – PHLs were heavy in Amuria and Katakwi districts in 2007. According to the CFSAM report (January 2008) poor storage conditions, damp floors, inadequate sunshine and high humidity caused high losses. These were estimated as follows cereals – 20%, pulses and oilseeds – 30% and roots and tubers – 40%. However, these figures are considered conservative for the two districts. Data requested are

Mozambique – had flooding in 1999/2000 (CFSAM 31 May 2000). In 1999/2000, the rainfall pattern was highly irregular and precipitation ranged from excessive to inadequate both between and within provinces. Generally, the rains were characterized by a late start in November 1999 followed by dry spells in December and then heavy rains in January 2000 and extreme rainfall in February and March. Consequently, planting was delayed and reseeding was necessary in many areas following germination failure or desiccation of young plants.

Overall, the national food supply in 2000/01 was expected to remain satisfactory. Floods and excessive rains devastated cereal production in southern areas, but these normally account for only 13 percent of total production. In the main cereal growing areas of the northern and central regions there was a good harvest, despite lower yields in parts. Including the second season cereals, to be harvested from mid-June, the Mission forecast the total 1999/2000 cereal production at 1.43 million tonnes, of which 994,000 tonnes, or 70 percent, is maize. Changes in the database in 2000 prevent strict comparisons with production estimates for

1998/99. However, roughly accounting for these changes, the Mission estimates that production of cereals is some 6-10 percent below the good crop of the previous year. This mainly reflects area losses to floods and dry weather, and a sharp decline in yields in southern provinces.

For cereal supply calculation, the allowance for seeds and post harvest losses was increased to reflect higher levels of losses and requirements for reseeding. Post harvest losses are estimated to be high even in normal years and this year for maize they were raised from 12% of production to 20% and for sorghum/millet from 12% of production to 15%. For rice it has been increased from 8 to 11%. For imported wheat, the figure remained 5%.

Swaziland - one very good example of PH losses in relation to extreme climate is the problem with damp maize harvest in Swaziland, reported by Francis De Lima in 1981 and 1982. Rainfall was high close to harvest and it was cloudy so a lot of maize was not properly dried and went rotten in the field. It seems the current problems with maize supply in Swaziland are due to a very different situation, too little rain at critical periods in maize cultivation.

2.1.6. Clustering provinces to share loss data

One problem faced in seeking to use PHL figures for cereals supply calculations is that for many locations there are no specific loss data. It is therefore inevitable that many different locations (provinces) will have to share the same data. This can be achieved by clustering together the provinces of many countries that are basically similar with respect to the factors that influence PH losses. The project looked at three approaches to doing this.

a) Crop proportions model
In this case the production data (usually 2004 – 2007) of each cereal crop for each province was screened from the database. Each province was then defined according to amount of production of each of the crops that it grows. The following categories (clusters) were defined after having looked at the data from 83 provinces (full data on the other provinces was not available at the time).

b) Crop yields model
In this case the yields data (usually 2004 – 2007) of each cereal crop for each of 89 provinces was screened from the database. The province yields were listed by crop and ranked. The rankings were clustered arbitrarily into high, medium and low yield.

c) Climate based model
The climate model for clustering involves determining the Köppen code (s) (Peel et al., 2007) for each province and then clustering provinces by code. Broadly the climates for the region fall into tropical (A), arid (B) and warm temperate (C) (see Figure 1). For the Horn of Africa, arid is the predominant climate for East and central Africa it is tropical (savannah) and for southern Africa it is temperate.

The most convenient model to emerge from this exercise was that based on climate classification since

- the separation between clusters is clear and logical
- the Köppen codes are easily understood and applied
- the system is full transparent
- there are simple ways that the clustering can be improved over time, and
- the loss data can be similarly coded so pairing of losses with clusters is simple.

For the present it is intended that the clustering process will remain manual and under review.

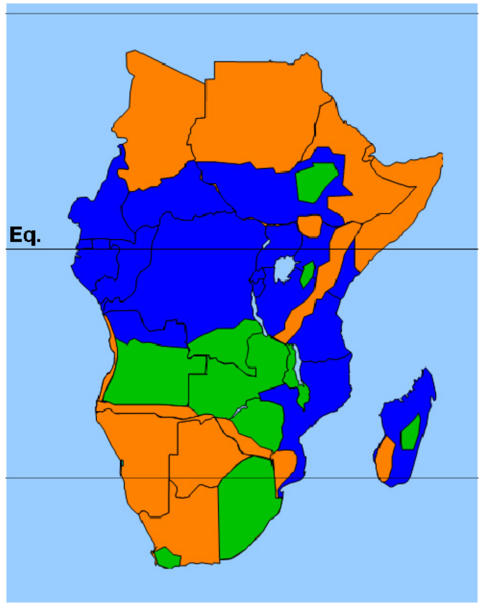


Figure 1: Rough distribution of tropical savannah/forest (blue), semi-arid/desert (organge) and warm temperate climates (green) in East and Southern Africa by Köppen climate classification

The choice of climate classification as a basis for clustering is particularly relevant to storage losses. Storage losses are known to vary according to crop type, climate and storage type. Climate is a key determinant of grain storage losses, since the biodeterioration factors that are the main agents of loss are dependant on conditions of temperature and humidity. Consequently, there is a close correlation between climate and store type. At one extreme, in hot humid climates farmers typically use very open storage structure to allow a substantial airflow and continuous drying and at the other extreme in hot dry climates farmers used sealed stored with no airflow since the crop enters store fully dried. Intermediate climates have stores designed with intermediate airflows. Examples of these stores types are shown in Annex 6. Crop type and climate may therefore offer a simple and easily understood approach to clustering provinces although cross checking by store type may be a useful way of judging cluster boundaries.

2.1.7. Generation of loss figures for province clusters

To give a generalised loss figures for each loss category, under each climate code, the figures in Annex 6 were summarised by

1. removing outliers
2. avoiding the use of 'Q/G' data where there is sufficient 'M' data, and then averaging what data remained.

The 'general' loss figures derived are listed in Table 6.

Table 6: General % weight loss estimates in storage for various crops grouped by climate classification for the locations where estimates made, adjusted to a 9-month storage period and an even household consumption pattern

Climate code	Small/large scale farming	Variety	Loss
	Maize cobs with LGB infestation		
Aw	small	local	9.7
BSh	large	local	2.7
	small	local	13.3
Cwa/Aw	large	local	2.1
	small	local	10.0
	Maize cobs no LGB		
Aw	small	local	5.3
BSh	small	local	4.3
Cwa	small	local	3.5
	small	HYV	9.5
	Maize grain with LGB infestation		
Aw	small	local	5.4
BSh	small	local	3.3
	Maize grain no LGB		
Aw	small	local	5.4
Cwa	small	local	4.2
	Sorghum grain		
BSh/BWh	small	local	2.5
Cwa	small	local	3.9
	Sorghum panicle		
Aw	small	local	2.8
	small	improved	11.0
	Millet		
BSh	small	local	1.1
Cwa	small	local	1.3
	Wheat		
BSh	small	local	3.1
Cwa	small	local	5.8
	Barley		
Cwa	small	local	0.8
	Rice		
Aw	small	-	1.2
BSh	small	-	0.1
Cwa	small	-	0.4
	Teff		
Cwa	small	local	0.3

The general figures show some variation by crop. Maize (without LGB infestation) as grain or cobs typically loses 4-5%, sorghum grain 2-4%, wheat 3-5%, millet 1%, barley, rice and teff 1% or less. Apart from maize and sorghum the actual number of individual figures contributing to the loss estimates for the other crops is low and so not much reliance can be placed on these generalisations. However, teff is an interesting case as it is well know to suffer few losses in store due to its very small grain size making it resistant to insect attack so the very low figure for storage loss is probably realistic even if the data source is poor. Indeed in Ethiopia one way to prevent infestation of maize grain is to mix it with teff, which fills the inter-granular spaces (Haile, 2006)

The situation with maize is more complex since it may or may not be infested by LGB. If cobs or grain are infested by normal storage pests, not LGB, weight losses from range from 4-5% (Table 5). When cobs are infested by LGB losses are about doubled (although it should be noted that the figure for BSh is entirely guesstimate and may be on the high side). Others arrived at a similar conclusion, losses doubling from about 5% to about 10% (Hodges *et al.* 1983; Dick, 1989; Boxall, 2002). However, LGB infestation has little or no effect on the losses of maize when this is stored as grain. This is not surprising as it is well known that LGB is more damaging on stabilised grain, as it is found on the cob, than on shelled grain (Cowley *et al*. 1980). Shelling grain and storing in sacks (as well as addition of insecticide) are the standard recommendations to limit LGB losses. Consequently, in the PHL losses model if LGB is recorded as problem then it is assumed that maize cobs are being stored and losses are multiplied by two.

Table 7: Comparison of the % weight losses estimates for maize stored as grain or as cobs with or without LGB infestation

Storage form	No LGB	LGB present	Climate code	Incremental increase due to LGB
Cobs	5.3	10.3	Aw	**1.9**
	4.3	13.3	BSh	**3.1**
	4.5	10.0	Cwa	**2.2**
Grain	5.4	5.4	Aw	**1.0**
	4.2	3.3	Cwa	**0.8**

In general the data on storage losses are too few to make comparisons between crops stored under different climates. Maize and sorghum offer modest data sets but with considerable variation between estimates in the method of data collection. In the case of maize there were no consistent differences between climate classifications in the observed losses (Fig. 2). This may be due to the inadequacy of the data or could be interpreted as resulting from the appropriate adaption of farmers working under different conditions, where they have adjusted their post harvest technology to minimise grain losses. In the case of sorghum losses might appear somewhat lower under hot dry conditions 2.5% (BSh) compared to temperate conditions 3.9 (Cwa) but the widely overlapping error bars for these two estimates suggest that the current data set are inadequate to confirm a genuine difference.

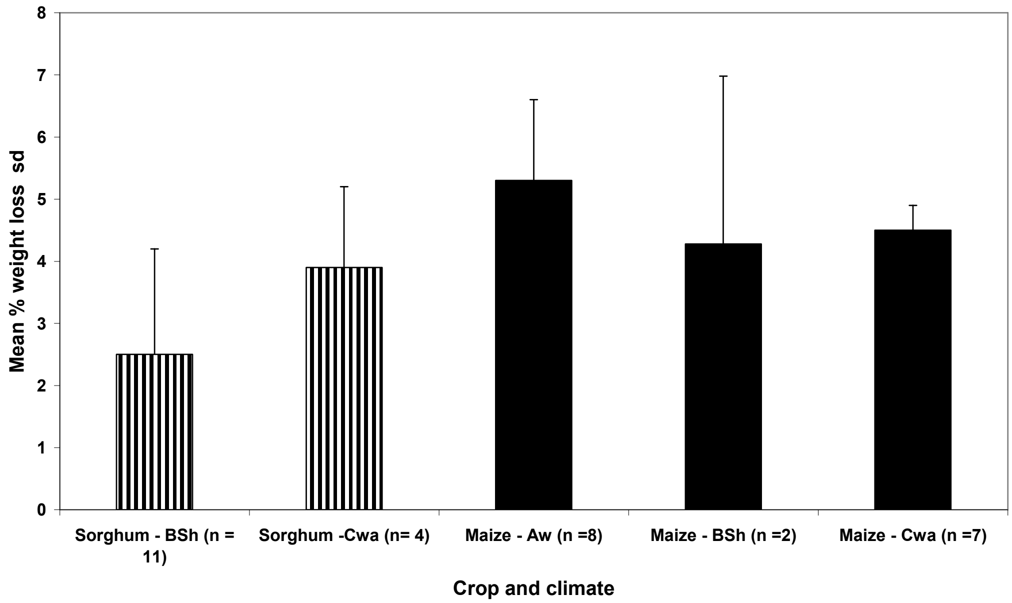


Figure 2: Mean % weight loss ±sd of stored sorghum grain or maize cobs (not LGB infested) under different climate conditions

2.1.8. Loss estimate for the whole PH chain

If the loss figures for each step in the PH chain of a particular crop are applied to the production estimates, it is possible to calculate a cumulative weight loss. The set of loss figures in this case is termed the 'loss profile'. Some examples of loss profiles for different crops and different climate clusters are shown in Table xx together with the calculated total cumulative loss where it is assumed that the grain is retained in farm storage and not sent to market. However, it is important to point out that that the cumulative losses shown are not necessarily those that would be determined for a particular situation since there are several other factors that would have to be taken into account that would have a very significant bearing on the actual loss estimate such as

1) whether or not the crop is harvested in one or two seasons
2) the proportions of grain produced by small scale and large scale farming,
3) whether or not there is bad weather at time of any of the harvests,
4) the proportion of grain that is market directly so will not enter storage for any significant time,
5) in the case of maize, whether or not LGB is expected to be a significant pest.

Table 8: Examples of loss profiles for various crops in various climate clusters

Climate cluster Crop Scale of farming	A* Maize Small	C Maize Large	B Sorghum Small	B Millet Small	A Rice Small
Harvesting/field drying	6.4	2	4.9	3.5	4.3
Drying	4	3.5	-	-	-
Shelling/threshing	1.2	2.3	4	2.5	2.6
Winnowing	-	-	-	-	2.5
Transport to store	2.3	1.9	2.1	2.5	1.3
Storage	5.3	2.1	2.2	1.1	1.2
Transport to market	1	1	1	1	1
Market storage	4	4	4	4	4
Cumulative % weight loss	17.9	11.3	12.6	9.3	11.4

* Climate codes – A – tropical, B – arid and C - temperate

2.1.9. Review papers on PH losses estimation

Two scientific publications have been prepared on APHLIS. The first was a paper to support the poster presentation at the 10th International Working Conference on Stored Products Protection –

Hodges, R.J., Bernard, M., Knipschild, H., Rembold, F., 2010. African Postharvest Losses Information System – a network for the estimation of cereal weight losses. In: Carvalho, M.O, Fields, P.G., Adler, C.S., Arthur, F.H., Athanassiou, C.G., Campbell, J.F., Fleurat-Lessard, F., Flinn, P.W., Hodges, R.J., Isikber, A.A., Navarro, S., Noyes, R.T., Riudavets, T., Sinha, K.K., Thorpe, G.R., Timlick, B.H., Trematerra, P., White, N.D.G. Proceedings of the 10th International Working Conference on Stored Products Protection. 27 June to 2 July 2010, Estoril, Portugal. 958-964.

and the following manuscript has been prepared as is soon to be submitted for publication in the Journal of Stored Products Research.

Hodges, R.J., Bernard, M., Knipschild, H., Rembold, F. Postharvest losses of cereal grains in the context of APHLIS an information system for the calculation, validation and dissemination of cereals postharvest loss data in Sub-Saharan Africa. Journal of Stored Products Research

3. Development of PH losses framework and model development

3.1. Rules and principles for loss estimation

The design of the PHL Information System to be used for enabling users to make loss estimates is presented in section 5.2. The current section will deal with the rules and principles of the loss estimation.

The estimation of PH losses will include as many steps in the postharvest chain as possible but of course only those for which there is loss data. These steps include

Harvesting loss
Field or platform drying
Threshing/shelling
Winnowing
Transport to store
Storage
Transport to market
Trader storage

The estimate will be determined as a 'cumulative' loss (i.e. one that takes into account previous losses from production) and will be made according to the following rules

1) The loss figure used will be either the most reliable one available or where there are several reliable figures then the mid-point of the range would be adopted after the exclusion of any obvious outliers.
2) Allowance will be made for whether the crop is being produced by large scale or small scale farming with separate loss estimates for each step in the PH chain (where these data are available).
3) Allowance will be made for whether there is more than one harvest.
4) In the case of storage losses the following rules will apply
    a. For the crop that will be marketed directly no farmer storage loss will apply
    b. If 3 months or less storage then no loss will apply
    c. If storage for 4 to 6 months then loss for half a storage season applies
    d. If storage for 7-9 months then loss for a whole storage season applies
    e. Allowance will be made according to whether the grain is stored threshed or unthreshed, e.g. maize as grain or as cobs, sorghum as grain or panicles.
    f. All storage loss figures will be corrected for grain consumption (disposal) at an even rate for each month of storage.
    g. Where maize is stored in provinces known to be subject to infestation by larger grain borer then larger losses will be applied.
    h. Special estimates of loss will be available where rain at harvest time or flooding is possible.

The rules governing the extent of losses in storage are based on a number of generalisations. Under normal conditions the rates of loss follow the general pattern described by Schulten and Westwood (1972) for maize held in farm stores in Malawi (Fig. 3). Little or no losses are experienced in the first three months of storage. Thereafter losses rise rapidly according to the susceptibility of the crop to damage. Hybrid varieties of maize tend to be very susceptible to damage (Fig. 3). Farmers do not normally store such maize but sell it for consumption very soon after harvest. Local and improved varieties are stored for home consumption and these suffer much lower losses.

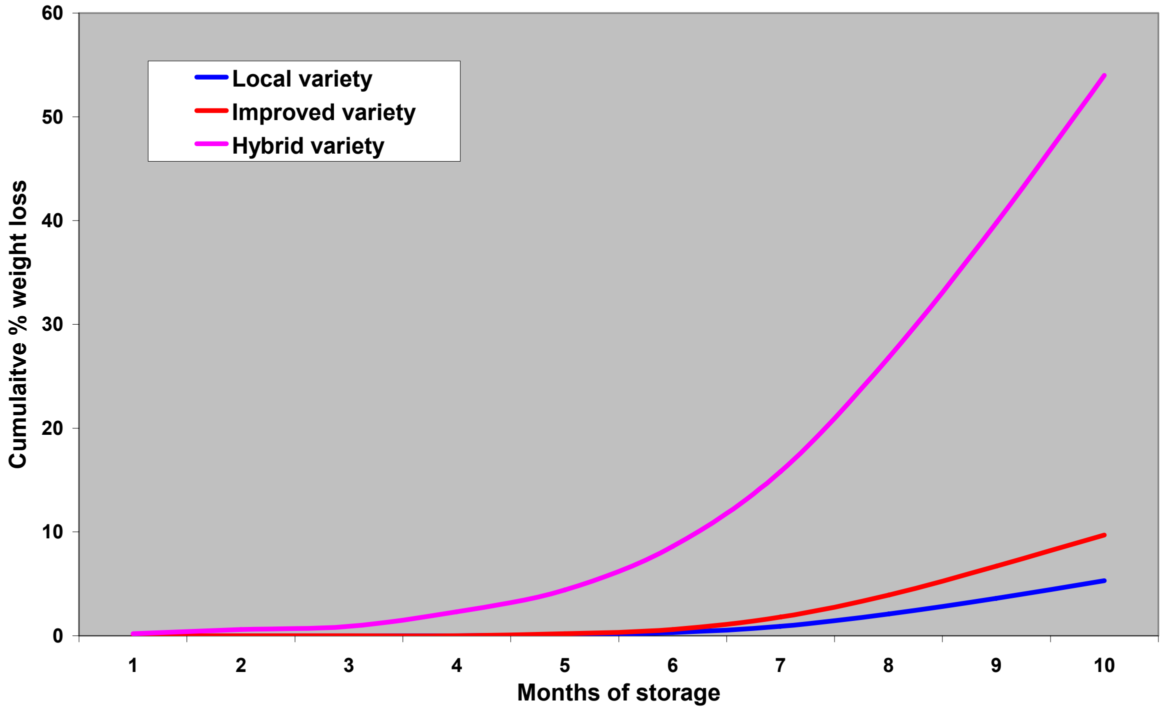


Figure 3: Cumulative % weight loss (not consumption corrected) for maize cobs held in farm stores in Malawi (Schulten and Westwood, 1972).

The storage periods for which there are loss estimates vary from study to study but interestingly the most common period is 7-9 months. It would seem that a typical storage season is 9 months. Most stores are empty by the time the new harvest comes in and the new harvest may be dried and processed for many weeks before entering storage. It would therefore appear that during the space of one year the usual storage season is about 9 months so for the purposes of loss estimation storage loss figures will be adjusted to a 9 month period. This can easily be done where there are several loss figures quoted over time which will suggest the shape of the curve describing losses and so the weight losses expected at 9 months can be predicted by extrapolation/interpolation. More difficult is when there is only a single loss figure. In this case lessons have to be drawn from situations where data are more complete. In nearly all cases, losses tend to be low in the first three months of storage, and then rise steadily in the following six months. Losses are predicted on this basis. Other farmers may have much shorter storage periods when crops other than cereals provide a substantial contribution to their food security, especially for example roots and tubers, or where they rely on two or more harvests of a particular crop each year. To account for these situations, the database will to be able to access estimated storage losses for a 4.5 month storage period.

Many of the storage losses estimates quoted in the literature do not take consumption into account. Consumption early in the storage season results in the disposal of grain with little or no loss. As the storage period increases so losses increase but only a small portion of the grain is subject to the high losses expected at the end of the storage period. For the purposes of this project, where authors have not applied a correction for consumption, this has been done. It has been assumed that consumption is even over a period of 9 months (11.1% of grain consumed per month). It is likely that many households do not have an even consumption pattern throughout the storage period. For example, consumption may be 'front loaded' so that within the first two or three months farmers sell grain to repay loans for agricultural inputs and raise funds for school fees. Better off, more confident farmers may show more ‘end loaded’ consumption since they will wait some time after harvest, when prices have risen, before selling grain. But it is assumed that on average consumption will be even. The effects of the consumption adjustments on storage loss figures are considerable. For example, the mean and range of some loss figures for maize storage losses during 9 months in Tanzania before consumption correction were 11% (2.1-34%) while after correction were 5.4% (0.9-11.6%).

Some examples of storage losses for a variety of cereal grains under different conditions are presented in Table 5. These are based on the figures collected from the literature, and corrected for a full storage season and even monthly consumption. For a full list of all the storage loss figures see Annex 6. These loss figures will be upgraded as further loss estimates are contributed by regional experts but most reliance will be placed on published figures generated by an appropriate loss assessment methodology.

Table 9: Suggested norms for weight losses for cereal grains[1] scaled to a full season of farm storage (7-9 months) and subject to an even consumption pattern

Cereal and condition	Normal range 9 months storage		Suggested norm	No. studies
	Min	Max		
Maize cob storage - LGB	8	12	10	7
Maize cob storage - no LGB	4	6	5	18
Maize grain - LGB	3	8	6	2
Maize grain - no LGB	5	8	5	6
Sorghum - grain	1.3	2.5	2	15
Sorghum - panicle	1	5	2.5	3
Wheat/barley	1	5	2.5	4
Millet	0.3	0.7	0.5	1
Teff[2]	1	1.9	1.5	0
Rice	1	1.4	1	2

[1]Where loss estimates do not include LGB then the losses presented are a result of the more usual insect pests and other factors (rodents, fungal damage etc).
[2]To date there are no studies detailing loss measurements in teff, only statements about what people think the loss rates might be.

3.2. Making PHL estimates

When users of the PHL Information System request estimates for the losses for a particular crop in a particular province then the set of appropriate PHL values for each step in the PH chain will be assembled and a cumulative loss calculated. The assembled PHL figures will be termed a PHL profile. The data used in the profile will be displayed and there will be access to information on the data sources. Some profiles for maize and sorghum losses are shown in Table 10. Section 5 of this report describes the details of the PHL Information System that will make the loss estimation and hold the components of the PHL profiles.

Table 10: Profiles of post harvest losses under a range of different conditions

Crop		Maize	Maize	Maize	Sorghum
Conditions	Storage	on cob	grain	on cob	grain
	Harvest	damp	dry	dry	dry
	Large grain borer (present/absent)	absent	absent	present	N/A
	Proportion of field dried/platform dried	100/0	50/50	50/50	100/0
	% of grain stored on farm (no marketing)	100	100	100	100
	% of grain stored by small scale farmers	100	100	100	100
Harvesting and drying losses					
Drying (field or platform)			-	-	
Field drying	Small-scale farming	16.6	6.6	6.6	7.6
	Large scale farming	-	-	-	
Platform drying	Small-scale farming	-	3.5	3.5	
	Large scale farming	-	-	-	
Threshing/shelling loss					
	Small-scale farming	2.5	2.5	2.5	11.5
	Large scale farming	-	-	-	
Winnowing loss					
	Small-scale farming	-	-	-	-
	Large scale farming	-	-	-	-
Transport to store loss					
	Small-scale farming	1	1	1	1
	Large scale farming				
Transport to market loss					
	Small-scale farming	-	-	-	-
	Large scale farming	-	-	-	-
Storage loss					
	Traditional small-scale farm storage	5	6	10	2
	Cumulative % loss	**23.5**	**12.9**	**17.5**	**17.4**

- data not available or not needed for this calculation

4. Development of the PH losses network and information system/database

4.1. The PHL network

The PHL network was established based on the agricultural networks of ASARECA and SADC. For each country (except Somalia and Djibouti) a national collaborator has been nominated and these people were the first contact points in attempting to bring together the network at the Regional Workshop held in Pretoria in June 2008.

Following that meeting there are now designated persons or national teams responsible for contributing data to the framework questionnaire (Annex 8), so that from the original 23 local experts at the meeting, the network has now grown to include 78 registered people. Most of the original 23 the national contact persons required support in data collection and entry and so sought help from within their own and other organisations. The project requested a list of these collaborators for each country. This list provides the project with several entry-points in case the main contact person is not available and, at a later stage, will also be helpful for further decentralisation of the network. At the end of August, each national team was requested to

a) indicate their ability to contribute the data requested in the framework questionnaire so that the project can anticipate problems in the collection of data, and
b) to agree with existing deadlines for data submission or to set their own deadlines for the submission of key elements of the data.

By the 23rd September 18 of the 19 countries that attended the South Africa meeting had responded and these were optimistic that in October they could provide the non-loss data (e.g. population, production, climate). However, most countries indicated that they are having difficulty finding data on post harvest losses. So at this stage it is anticipated that the post harvest loss data available for the database will probably not be much more than that already collected from the literature.

The two countries that attended the meeting but which have not yet responded are Tanzania are Zambia. In addition, there are gaps in our coverage as although Burundi and Mauritius have nominated country representatives they have not yet shown any signs of participation.

4.2. The PHL information system and database

PHL Information System can be found on the internet at http://www.aphlis.net.
A calculation fact sheet facility has been developed so that users of APHLIS can see the full PHL calculation and the sources of the data that have been used, including a rating of the data sources (see Annex 4 for an example). This development allows network members to assess the performance of APHLIS

The home page describes the system and offers users two routes to obtain estimates of PHLs. The users can access PHL estimates calculated by the PHL model using data submitted by the PHL network. Alternatively the user can download a spreadsheet in which it is possible to change the default values and arrive at estimates based on user defined conditions at whatever geographical scale or climate is appropriate. The spreadsheet version also enables the user to trace the origin and the quality of the figures used in the PHL profile that is used for the loss calculation.

The website also offers two downloads to help the user understand the system – a User's Guide and a review paper on 'Postharvest weight loss estimates for cereal supply calculations in East and Southern Africa'.

5.2.1 PHL values calculated from data submitted by the PHL network
A series of PHL tables can be accessed from the web page. The first table gives total regional annual losses for all cereals for the years 2003 to 2008.

Estimated Post Harvest Losses (%) 2003 - 2010

Weighted average according to reported figures

Regional total PHL for cereals [% of total annual production]					
2006	**2007**	**2008**	**2003**	**2004**	**2005**
14.8	15.1	17.4	17	14.4	14.3

Appearing just below this there is a breakdown of these figures by cereal.

Regional PHL by cereal [% of total annual production]								
Cereal	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
Maize	22	16.4	16.2	17.7	17.8	22.4	-	-
Barley	9.9	8	9.7	9.7	9.7	-	-	-
Wheat	13.3	9	13.6	11.5	11	-	-	-
Sorghum	12.4	12	12.1	12.3	12.2	12.5	-	-
Millet	10.9	12.4	12.2	12.2	12.3	12.5	-	-
Rice	11.1	10.9	11	11	11.1	-	-	-
Teff	11.7	11.7	11.7	11.7	11.7	-	-	-
Fonio	-	-	-	-	-	-	-	-
Rye	-	-	-	-	-	-	-	-
Oats	-	14.5	14.3	14.5	14.5	-	-	-

If the user clicks on one of the cereal crops then a table of PHL value is given for each of the participating countries. The example shown below is for maize.

Estimated Post Harvest Losses (%) 2003 - 2010

Weighted average according to reported figures

Back

Maize								
Country	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
Angola	-	-	-	-	-	-	-	-
Botswana	-	16.5	15.5	16.9	14.4	-	-	-
Burundi	-	-	-	-	-	-	-	-
DR Congo	-	-	-	-	-	-	-	-
Eritrea	20.7	20.5	20.7	20.7	17.9	-	-	-
Ethiopia	-	17.9	17.9	17.8	16.4	-	-	-
Kenya	-	-	-	-	21.1	-	-	-
Lesotho	-	17.2	17.2	17.2	17.2	-	-	-
Madagascar	-	17.4	17.4	-	-	-	-	-
Malawi	-	20.4	20.4	20.6	19.6	-	-	-
Mozambique	21.6	19	19.4	21.1	21	-	-	-
Namibia	12.1	-	-	-	16.3	18.7	-	-
Rwanda	-	-	-	17.9	17.5	-	-	-
Somalia	-	20.7	20.7	20.7	20.7	20.7	-	-
South Africa	-	12.3	12.3	12.4	12.3	-	-	-
Sudan (north)	-	-	-	-	-	-	-	-
Sudan (south)	20.9	20	19.6	21.1	18	-	-	-
Swaziland	-	17.2	17.2	17.2	18.7	-	-	-
Tanzania	22.3	22.2	22.3	22.3	22	-	-	-
Uganda	-	17.9	17.9	17.9	16.3	22.5	-	-
Zambia	-	17.7	18.1	19.3	16.5	-	-	-
Zimbabwe	-	-	-	14.5	27.4	-	-	-

Back

NB Annual averages are a weighted average of the seasons

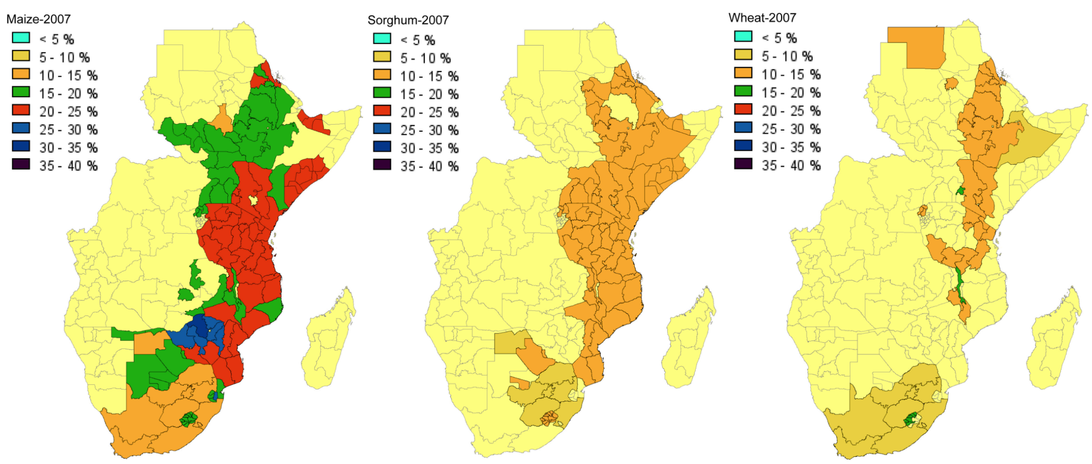
The user may then click on a country for the PHL values of each province, for example Zimbabwe.

Estimated Post Harvest Losses (%) 2003 – 2008

For Maize in Country: Zimbabwe

Province	2003	2004	2005	2006	2007	2008
Manicaland	-	-	-	13.4	25.3	-
Mashonaland Central	-	-	-	13.4	27.9	-
Mashonaland East	-	-	-	13.4	27.9	-
Mashonaland West	-	-	-	21.1	31.5	-
Masvingo	-	-	-	15.1	22.6	-
Matebeleland North	-	-	-	16.5	28.2	-
Matebeleland South	-	-	-	15.1	22.6	-
Midlands	-	-	-	13.4	27.8	-

To provide users with an overview of loss by province and other key data (e.g. countries/provinces with LGB problems), a PHL map function is available (Figs 4 & 5). For losses this offers figures based on 2007 default values.



PHL values in 2007

Maize **Sorghum** **Wheat**

Figure 4: Countries/provinces showing maize, sorghum and wheat losses for 2007

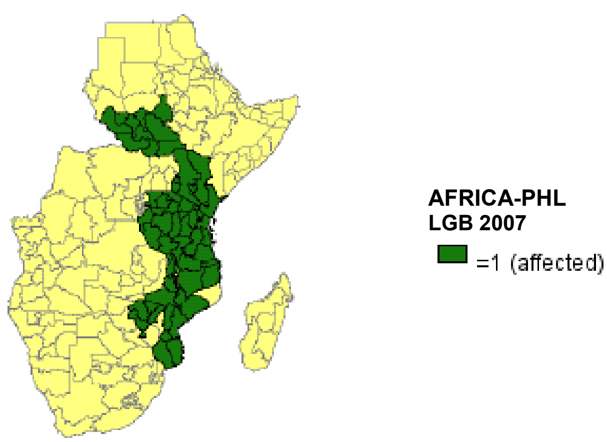


Figure 5: Countries/provinces declaring a problem with LGB infestation in 2007

5.2.2 PHL estimates calculated from user defined values using a downloadable spreadsheet

The user can download a spreadsheet in which it is possible to change the defaults. The sheet is divided into three areas each in a different colour for easy identification.

Front page (Fig. 6a) - On the first page of the spreadsheet, the user can select an appropriate language, English, French or Portuguese.

Data Input Area (Fig. 6b) - At start-up the data input area is filled with default values from 2007 that were provided by the national teams during data collection and the loss profile for the selected province and crop. The user may then obtain reasonable estimates for different years by adjusting the blue figures.

For each harvest season the user will be allowed to adjust the loss computation to take five factors into account. These factors are necessarily generalisations and they affect the loss estimate as follows:

- **Rain at harvest** - affects the % harvesting loss. If there is rain at harvest then the % figure in the profile is multiplied by 3.
- **Storage duration** - affects the % storage loss. If the duration is less then 3 months then the %storage loss figure is set to zero. If the duration is 4 to 6 months then the %storage loss figure if divided by 2 (i.e. is only half the annual figure). If grain is stored for 7 or more months then the annual %storage loss figure of the cluster profile is used.
- **LGB a serious problem** - only applies for maize and has an effect of doubling the % storage loss (see Section 3.7).
- **Proportion produced by small or large scale (commercial) farmers** – a different loss profile is used for each.
- **Proportion of grain marketed** - affects the proportion for which storage losses are considered. Furthermore it is assumed that subsistence farmers eventually consume all grain that is not marketed so this stock suffers no transport to market or trader store losses.
- **Total production at harvest** – affects the loss calculation when there is more than one harvest for a crop since losses will computed as a weighted average.

The Loss Calculation Area (Fig. 6c) – This gives details of the loss profiles being used and the cumulative loss at each step in the PH chain. The total annual cumulative loss for all harvests, including for small scale and commercial farms, is presented at the bottom of this table, 16.3% in this case, together with a series of graphs to indicate a breakdown of the loss components Fig. 6d). Using the same crop and province but different settings (see below) where all the maize is produced and stored by subsistence farmers and not marketed and there was no LGB threat then the loss amounts to 17%.

Climate n°	1											
Climate	Tropical savannah climate (Aw)											
	1st season				2nd season				3rd season			
Farm type	subsistence		commercial		subsistence		commercial		subsistence		commercial	
Production	36214	tonnes	0	tonnes	89164	tonnes	0	tonnes	0	tonnes	0	tonnes
Marketed at harvest	4	% (0-100)	0	% (0-100)	4	% (0-100)	0	% (0-100)		% (0-100)		% (0-100)
Rain at harvest		1=yes		1=yes		1=yes		1=yes		1=yes		1=yes
Storage duration	9	months	0	months	9	months		months		months		months
Larger Grain Borer	1	1=yes	1	1=yes	1	1=yes		1=yes		1=yes		1=yes

Rain at harvest under these circumstances would increase the loss to 28% and if LGB was also a serious problem then the loss would rise to 32%. The loss calculations become increasingly more complex when there is both subsistence and commercial farming and more than one harvest.

Tracing Loss Values Area (Fig. 6e) – This presents the quality (reliability) of the data sources used in the losses profile. It is from here that the user can gauge whether the loss estimate used for each step in the PHL profile is 'same', meaning that the crop, climate or scale of farming in the profile are specific to the situation or 'other' meaning that the closest applicable figures but not specific ones are being used. It would be anticipated that where 'same' figures are being used the estimate is more reliable. You will see in Figure 3d that for subsistence farming with the exception for losses in market storage, all the figures used in this case are 'same' whereas for commercial farming many of the figures are 'other'.

Besides seeing whether the profile figures are 'same' or 'other' there is also a record of how the figures were derived under the 'Method' column. Figures are either 'measured' in which objective techniques have been used to estimate a loss value or they are 'questionnaire/guesstimate' meaning that they are less objective (but not necessarily less accurate.

Finally there is a table which gives the loss profile figures used for subsistence or for commercial farmers against which there are numbers. The first figure (highlighted) has no reference number against it (Fig. 7), this is the general figure derived from the other estimates in the same row. These other figures are those taken from the literature or submitted to the PHL database, each has a reference number which refers to a bibliographical source that is listed at the 'References' tab of the spreadsheet.

	Data and references for the PHL profile of subsistence farms																						
	Number		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Harvesting/field drying	reference n°		13	33	51	53	71	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	figure	6.4	2	9.9	5.8	9.5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Figure 7 – Section of the 'Tracing Loss Values Area' which shows a general loss figure for harvesting and field drying (highlighted) and the estimates from which it is derived. Each of these estimates has a reference number that can be used to identify the data source in a reference list.

A comment function allows users to send their suggestions to the operator for improvement to the system, especially new measures of post harvest losses for specific elements of the post harvest chain that could be used to update/improve PHL profiles.

Calculation of post harvest losses for a country (Fig. 6f)

The last facility of the spreadsheet is a table into which the user can record the PHL estimates made for one crop in each area (province) of a country. The table can be built up as the spreadsheet is used to make an estimate for each area. It will display the final total loss estimate.

Figure 6a: Front page of the spreadsheet offering language selection

Cereals Post Harvest Loss Calculator - East and Southern Africa

Home | Data Entry Area | PHL matrix | PHL estimates | Graphs 1 | Graphs 2 | Quality | Sources | Country PHL | References

Data Entry Area - Please modify the figures in blue

Labelling	Country	Tanzania			Province	Arusha			Year	2007		
	Enter another figure below to select a crop: 1=maize; 2=rice; 3=sorghum; 4=millet; 5=wheat; 6=barley; 7=teff											
Cereal n°	1											
Cereal	Maize											
	Enter another figure below to select a climate: 1=Tropical savannah climate; 2=Semi-arid climate; 3=Temperate climate dry winter hot summer; 4=Temperate climate dry winter warm summer; 5=Desert climate											
Climate n°	1											
Climate	Tropical savannah climate (Aw)											
	1st season				2nd season				3rd season			
Farm type	subsistence		commercial		subsistence		commercial		subsistence		commercial	
Production	36214	tonnes	0	tonnes	89164	tonnes	0	tonnes	0	tonnes	0	tonnes
Marketed at harvest	4	% (0-100)	0	% (0-100)	4	% (0-100)	0	% (0-100)		% (0-100)		% (0-100)
Rain at harvest		1=yes		1=yes		1=yes		1=yes		1=yes		1=yes
Storage duration	9	months	0	months	9	months		months		months		months
Larger Grain Borer	1	1=yes	1	1=yes	1	1=yes		1=yes		1=yes		1=yes

Figures in blue can be set by the user

Figure 6b: Data entry into the PH losses computation matrix

PHL (%) Calculation: Maize - Arusha - Tanzania - 2007

1st season

Farm type	subsistence					commercial				
Share of production	100									
Destination		store		market			store		market	
Share		96		4.0						
Steps	adjusted PHL profile	remaining grain	loss increment	remaining grain	loss increment	adjusted PHL profile	remaining grain	loss increment	remaining grain	loss increment
Harvesting/field drying	6.4	90	6.2	4	0.3	2.0				
Platform drying	4.0	86	3.6	4	0.1	3.5				
Threshing and Shelling	1.2	85	1.0	4	0.0	2.3				
Winnowing	-					-				
Transport to farm	2.3	83	2.0			1.9				
Farm storage	10.5	74	8.8							
Transport to market	1.0			4	0.0	1.0				
Market storage	4.0			3	0.1	4.0				
Total		74	21.6	3	0.6					
Grain remaining	77.8									
Lost grain	22.2									
Grain remaining	77.8									
Lost grain	22.2									

2nd season

Farm type	subsistence					commercial				
Share of production	100									
Destination		store		market			store		market	
Share		96		4.0						
Steps	adjusted PHL profile	remaining grain	loss increment	remaining grain	loss increment	adjusted PHL profile	remaining grain	loss increment	remaining grain	loss increment
Harvesting/field drying	6.4	90	6.2	4	0.3	2.0				
Platform drying	4.0	86	3.6	4	0.1	3.5				
Threshing and Shelling	1.2	85	1.0	4	0.0	2.3				
Winnowing	-					-				
Transport to farm	2.3	83	2.0			1.9				
Farm storage	10.5	74	8.8							
Transport to market	1.0			4	0.0	1.0				
Market storage	4.0			3	0.1	4.0				
Total		74	21.6	3	0.6					
Grain remaining	77.8									
Lost grain	22.2									
Grain remaining	77.8									
Lost grain	22.2									

3rd season

Farm type	subsistence					commercial				
Share of production										
Destination		store		market			store		market	
Share										
Steps	adjusted PHL profile	remaining grain	loss increment	remaining grain	loss increment	adjusted PHL profile	remaining grain	loss increment	remaining grain	loss increment
Harvesting/field drying	6.4					2.0				
Platform drying	4.0					3.5				
Threshing and Shelling	1.2					2.3				
Winnowing	-					-				
Transport to farm	2.3					1.9				
Farm storage										
Transport to market	1.0					1.0				
Market storage	4.0					4.0				
Total										
Grain remaining										
Lost grain										
Grain remaining										
Lost grain										

Total remaining	78	%
Annual loss	22	%

PHL (tonnes) Calculation: Maize - Arusha - Tanzania - 2007

	1st season		2nd season		3rd season	
Farm type	subsistence	commercial	subsistence	commercial	subsistence	commercial
Production	36,214		89,164			
Grain remaining	28,182		69,388			
Lost grain	8,032		19,776			
Production	36,214		89,164			
Grain remaining	28,182		69,388			
Lost grain	8,032		19,776			

Annual production	125,378	tonnes
Total remaining	97,570	tonnes
Annual loss	27,808	tonnes

Figure 6c: Loss calculation area (part 1)

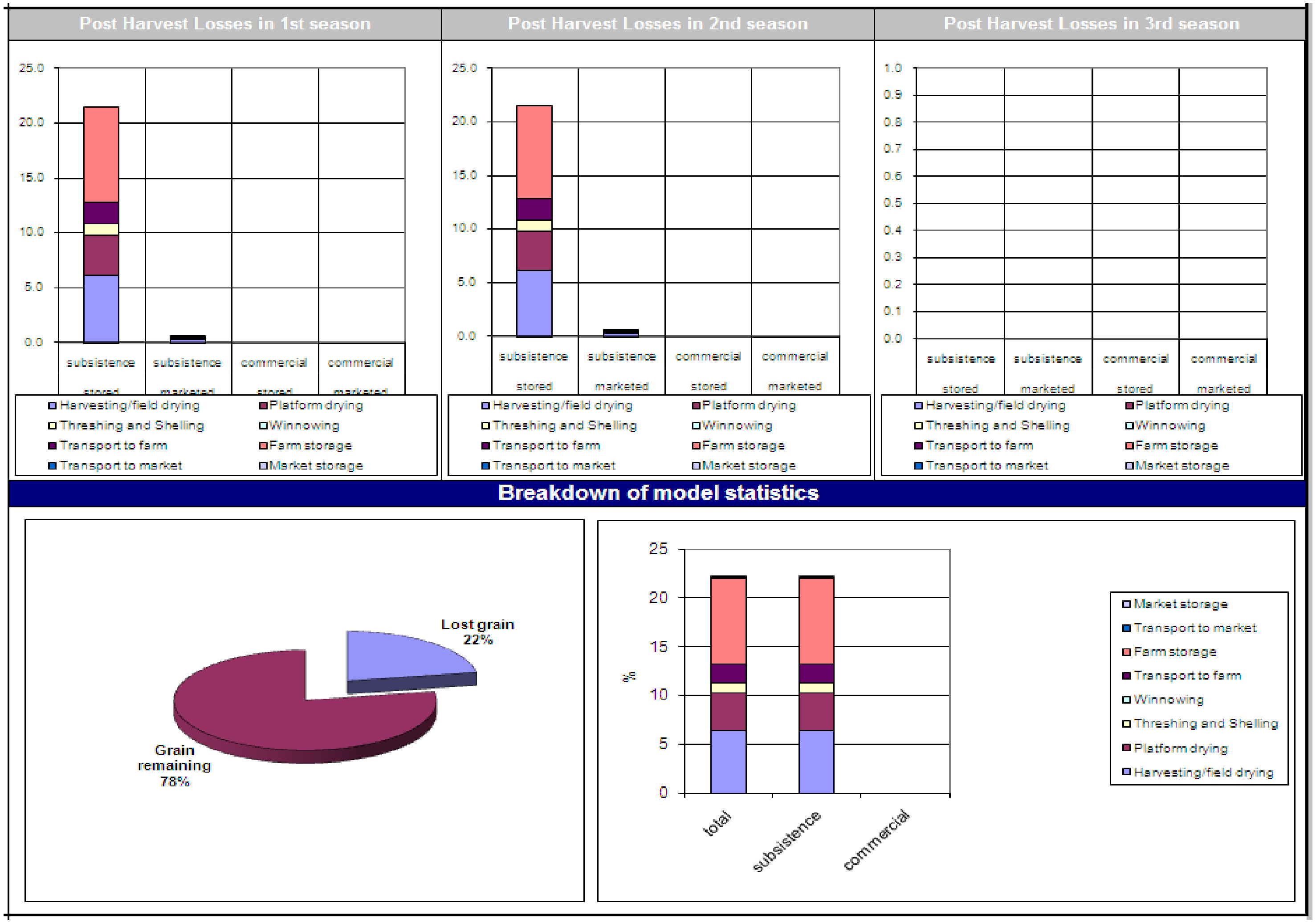


Figure 6d: – Loss calculation area (part 2)

Tracing Loss Values Area

Default PHL profile as defined by this crop and climate

Farm type / Steps	Subsistence farming %	Cereal	Climate	Farm type	Method	Commercial farming %	Cereal	Climate	Farm type	Method
		Origin of figure					Origin of figure			
Harvesting/field drying	6.4	Maize	other	subsistence	questionnaire/guesstimate	2.0	other	other	commercial	questionnaire/guesstimate
Platform drying	4.0	Maize	other	subsistence	questionnaire/guesstimate	3.5	Maize	other	commercial	questionnaire/guesstimate
Threshing and Shelling	1.2	Maize	other	subsistence	questionnaire/guesstimate	2.3	Maize	other	commercial	questionnaire/guesstimate
Winnowing	-	-	-	-	-	-	-	-	-	-
Transport to farm	2.3	Maize	other	subsistence	questionnaire/guesstimate	1.9	Maize	other	commercial	questionnaire/guesstimate
Farm storage	5.3	Maize	Aw	subsistence	measured estimate	2.4	Maize	Aw	commercial	questionnaire/guesstimate
Transport to market	1.0	Maize	other	subsistence	questionnaire/guesstimate	1.0	Maize	other	commercial	questionnaire/guesstimate
Market storage	4.0	other	other	subsistence	questionnaire/guesstimate	4.0	other	other	commercial	questionnaire/guesstimate

References and individual loss figures %

Data and references for the PHL profile of subsistence farms

Step	Number	%	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Harvesting/field drying	reference n°		13	33	51	53	71	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	figure	6.4	2	9.9	5.8	9.5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Platform drying	reference n°		45	53	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	figure	4.0	3.5	4.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Threshing and Shelling	reference n°		13	33	51	53	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	figure	1.2	1	0.3	2.5	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Winnowing	reference n°		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	figure	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Transport to farm	reference n°		13	73	73	73	73	53	71	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	figure	2.3	2	2	2	2.3	4	1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Farm storage	reference n°		18	18	18	18	26	27	52	67	-	-	-	-	-	-	-	-	-	-	-	-	-
	figure	5.3	4.6	5.2	6.2	7.3	3.1	6.1	4.6	5	-	-	-	-	-	-	-	-	-	-	-	-	-
Transport to market	reference n°		53	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	figure	1.0	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Market storage	reference n°		13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	figure	4.0	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Please note that the loss figures of this general profile are adjusted in the loss calculation matrix above (adjusted profile) for 'rain at harvest', 'storage duration' and problems with the 'larger grain borer' according to the data you enter.

Data and references for the PHL profile of commercial farms

Step	Number	%	1																				
Harvesting/field drying	reference n°		13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	figure	2.0	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Platform drying	reference n°		45	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	figure	3.5	3.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Threshing and Shelling	reference n°		13	53	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	figure	2.3	1	3.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Winnowing	reference n°		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	figure	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Transport to farm	reference n°		13	73	73	73	73	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	figure	1.9	2	0.5	2	2.1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Farm storage	reference n°		73	73	73	73	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	figure	2.4	1.7	2.7	2.5	2.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Transport to market	reference n°		53	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	figure	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Market storage	reference n°		13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	figure	4	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Please note that the loss figures of this general profile are adjusted in the loss calculation matrix above (adjusted profile) for 'rain at harvest', 'storage duration' and problems with the 'larger grain borer' according to the data you enter.

Figure 6e: Tracing loss values area

figure – the % loss figures used in the calculation, the highlighted figure is general loss subsequent figures are those used to derive the general figure, reference no. = the number of the data source given in the reference list

Calculation of post harvest losses for a country						
	Country	Tanzania	Year	2007		
Cereal	Province	Annual production	Annual loss	Total remaining	Share of total production	Share of total losses
		tonnes	tonnes	tonnes	%	%
Maize	Arusha	125,378	26,233	99,145	84.2	88.4
Barely	Arusha	23,456	3,456	20,000	15.8	11.6
Total		148,834	29,689	119,145	100	100
Total remaining	80%					
Annual loss %	20%					

Figure 6f: Accumulating PHL figures by province for a country and estimating the total loss

5. Conclusions and future directions

5.1. Conclusions

Prior to the development of APHLIS, PHL assessments were based on ad-hoc measurements resulting in wide ranges. In APHLIS, weight loss estimates are derived from the best known estimates of the loss for each phase in the post harvest chain (harvesting, drying, shelling, winnowing, transport to store, storage etc). Loss figures for each province and cereal crop are adjusted considering the relevant agro-ecological factors like climate and scale of farming (commercial or subsistence) and seasonal conditions such as the weather conditions at harvest and the share that is marketed at harvest. The process used to produce the provincial estimates and the process of aggregation to provide national and regional estimates is fully transparent.

The results can be viewed as interactive maps or as tables. PHL tables can be clicked to reveal a complete breakdown of the loss calculation, the sources of the data and an appraisal of the quality of the data used, thus users can scrutinize PHL estimates.

Because APHLIS offers a downloadable version of the loss calculator as an Excel spreadsheet, it can be used for simulating different scenarios. Another advantage of the platform is that it can be easily upgraded as more reliable data becomes available.

5.2. Sustainability and further development

During the final meeting in Bonn in August 2010, discussions were held on possible further developments of the system and on its long term sustainability.

The following factors were identified as central for future APHLIS developments:

- Verifying reliability of the current estimates
- Retrieving additional PHL figures and update PHL estimates
- Widening the scope and geographical range of the PHL information system
- Linking PH losses estimates with PH losses reduction projects
- Upgrading the website

6.2.1 Verifying reliability of the current estimates

More efforts are required to screen the system for anomalous estimates and identify significant variations between years. A good example mentioned by GIEWS expert are the figures for Zimbabwe (Mashonaland West which rose from 21.1 to 31.5% between 2006 and 2007). This difference was due to rain at harvest in 2007, but when GIEWS repeated the exercise with the network member in Zimbabwe using the downloadable calculator a lower loss level was accepted; one not including rain at harvest. This suggests that there needs to be 1) follow up to obtain a detailed explanation when losses are significantly changed, with the explanation presented as a note on the website, and 2) a more detailed definition of rain at harvest (beyond that given on the website) 3) a longer series of PHL estimates in order to have both updated values and historical values for comparison

6.2.2 Retrieving additional PHL figures

The project is faced with making loss estimates based on very scarce PH losses data. In the medium term, the project would benefit greatly from the supply of additional loss figures and a text is required that explains to both the PHL network and other interested parties how they should go about this.

To strengthen the ability of target countries to collect relevant data, in the format need by the project, a training manual should be prepared that outlines a modern approach to loss assessment for the major cereal crops from harvest through to storage. Currently, such advice is spread throughout the scientific literature in a variety of formats and in relatively inaccessible scientific papers. The guide would go beyond just the production of loss figures but would place emphasis on the importance of calculating cumulative losses including the effects of household consumption of stored grain. The preparation of the guide should include a meeting at a location in one of the project target countries (preferably at a research station) to validate the approaches being suggested, finalise the draft and offer further practical guidance to those who will be actually using the recommended methods.

6.2.3 Widening the scope and geographical range of the PHL information system
There are opportunities to increase the benefits derived from this project. The existing system could be expanded to include pulses, grain legumes, which are traded and stored in much the same way as cereals and subject to their own PHLs. According to several users, APHLIS should develop beyond weight losses into areas of grain quality and losses linked to contamination with toxins such as aflatoxins.

The geographical coverage could also be widened, the first logical step would be the include West Africa although in time this could also include South Asia and South America.

6.3.4 *Linking PH losses estimates with PH losses reduction projects*
There are some initiatives ongoing on PHL reduction in Africa (managed for example by FAO, the WB and the AfDB) and APHLIS was developed in coordination with the promoting institutions. In the long term however the system has to take care to remain a useful starting point for such initiatives and to include more PH information in order to become the focus point of a PH related community of practice.

6.3.5 *Upgrading the website*
The website should be upgraded so that adjustable variables for the model (e.g. rain at harvest) are better explained and by providing a means for posting a commentary on APHLIS about loss figures so that inter annual variations can be explained. A question and answer service on how to use the website in an optimal way was also suggested.

6.3 Proposal to the World Bank Trust Fund for Statistical Capacity building

Participants of the final workshop agreed that a proposal should be submitted to the World Bank Trust Fund for Statistical Capacity Building that would:

a) extend APHLIS capacity to include West African cereals

b) enable people currently handling agricultural statistics/information in West Africa to participate in the APHLIS

c) extend African capacity to collect PHL data using a standardised loss assessment approach

d) add capacity to APHLIS so that its statistics on PHLs can be used by projects and institutions to deliver more effective postharvest loss reduction.

The proposal would be developed by NRI and ISICAD and be prepared in consultation with other stakeholders (JRC, FAO). ISICAD agreed to contact FARA to explore the possibility of them articulating African demand for upgrading APHLIS to include West Africa, and other features of the Trust Fund proposal. ISICAD also agreed to follow up with CTA concerning support for the network.

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Annex 1: APHLIS leaflet

APHLIS

African Postharvest Losses Information System
– a network for the estimation of cereal weight losses

APHLIS provides transparent estimates of postharvest losses for cereals in Eastern and Southern Africa at national and provincial scale

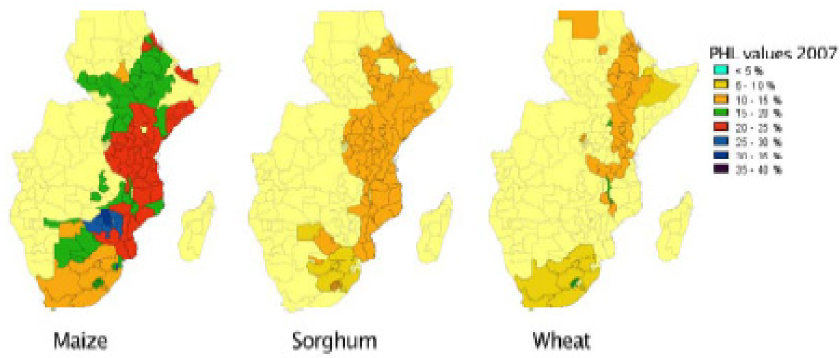
Background

Agriculture is being challenged to produce ever more food for a rapidly growing world population. This problem is exacerbated by competition for limited physical resources and the negative impacts of climate change on the environment. Food prices are not expected to decrease in this high demand and high risk scenario, so that postharvest losses (PHLs) have a central role in agricultural monitoring. Reliable PHL figures are important for a better targeting of loss reduction programmes and are essential for the estimation of food availability in countries threatened by food insecurity.

What the system does

APHLIS provides estimates of weight losses of cereal grains in Eastern and Southern Africa by country and by province. These can be viewed on the *APHLIS* web site at http://www.phlosses.net as interactive maps or as tables of loss values.

Loss estimates: maps



Loss estimates: table

Regional total PHL for cereals [% of total annual production]					
2003	2004	2005	2006	2007	2008
17	14.4	14.3	14.8	15.1	17.4

Regional PHL by cereal [% of total annual production]

Cereal	2003	2004	2005	2006	2007	2008	2009
Maize	22	16.4	16.2	17.7	17.8	22.4	-
Barley	9.9	8	9.7	9.7	9.7	-	-
Wheat	13.3	9	13.6	11.5	11	-	-
Sorghum	12.4	12	12.1	12.3	12.2	12.5	-

PHLs are the sum of all the weight losses from each link in the postharvest chain. By convention, they do not include any losses from processing (e.g. milling) and in this system do not include quality losses if food is still fit for human consumption.

Components of the system

APHLIS is based on the following components:

- **A network** - of local experts from each country in the region; this is the basis to APHLIS. The network members supply relevant data and verify loss estimates.
- **A central database** - holding relevant data by country and by province for the calculation of losses.
- **A loss calculator** - based on a simple model that calculates losses from all provinces of the countries in the region. Loss estimates are derived from the best known estimates of the loss for each link in the postharvest chain allowing for crop type, climate and scale of farming (commercial/subsistence). Further corrections are applied for a range of other factors.

Key features for the user

APhLIS users get a lot more than just static PHL figures:

- APHLIS offers a downloadable version of the loss calculator as an Excel spreadsheet. Users can change default values to those relevant to their situation and generate PHL estimates for any geographical scale.
- APHLIS PHL tables can be 'clicked' to reveal a complete breakdown of the loss calculation, the sources of data and an appraisal of the quality of the data used. Users can subject PHL estimates to critical examination.
- APHLIS is easily upgraded as more reliable loss data become available. Users can contribute their loss data and, if it can be demonstrated to be better than existing data, will be added to the database.
- APHLIS will be updated annually. Users will be able to see trends in PHL data across years.

Future development and other uses

APHLIS offers a robust system for the estimation of PHLs, is transparent in operation and can capture improvements in loss estimates, so it promises to be a means by which more accurate loss estimation can be achieved. For the future there will be

- a drive to improve the accuracy of the APhLIS by generating more data for the losses at the various links in the postharvest chain.
- an expansion of the technical content of the new system to include beans and of geographical coverage to include West Africa, Asia and Central and South America
- new uses, for example as climate change makes unseasonal climatic events more common, new data on how these events affect postharvest losses at one location can be included in the model so that future impacts on a wider geographical range can be predicted.
- Coordination with other PHL systems and projects such as: WB, UNIDO, FAO...

For more information

Please contact info@phlosses.net

Acknowledgements

APHLIS was created within the work programme of the European Commission's Joint Research Centre (Italy) and implemented with the Natural Resources Institute (UK) and ISICAD/BLE (Germany). In Africa, the team included the regional research organisations ASARECA and SADC/FANR and their national experts contributed through the PHL Network. The project was overseen by a steering committee provided by the UN Food and Agriculture Organisation (FAO), Joint Research Centre (EC) and AIDCO (EC). Advice and feedback was also obtained from FAO's Global Information and Early Warning System (GIEWS).

www.phlosses.net

Annex 2: APHLIS poster

APHLIS

African Postharvest Losses Information system - an network for estimation of cereal weight losses

Rick Hodges[1], Marc Bernard[2], Henning Knipschild[2] and Felix Rembold[3]

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Background

Agriculture is being challenged to produce ever more food and this problem is exacerbated by competition for limited physical resources and the negative impacts of climate change on the environment. Food prices are not expected to decrease in this high demand and high risk scenario, so that postharvest losses (PHLs) have a central role in agricultural monitoring.

Reliable PHL figures are important for a better targeting of loss reduction programmes and are essential for the estimation of food availability in countries threatened by food insecurity. Losses in storage are a large component of the overall PHL.

What are the postharvest losses calculated by APHLIS

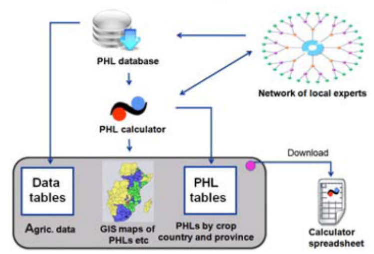
APHLIS provides estimates of weight losses of cereal grains in Eastern and Southern Africa by country and by province. These can be viewed on the APHLIS web site at as interactive maps or as tables of loss values.

APHLIS PHLs are the cumulative weight losses from each link in the postharvest chain. They do not include any losses from processing (e.g. milling) or quality losses when food is still fit for human consumption. Data for the estimation of losses were derived for an exhaustive survey of the literature and are submitted by the APHLIS network of local experts who control and manage their data in the APHLIS database.

APHLIS provides transparent calculations of postharvest losses for cereals in Eastern and Southern Africa at national and provincial scale

Components of the system

- Network of local experts from 16 countries providing data and verifying PHLs determined by the calculator.
- Database of key data accessible by local experts, by country.
- PHL Calculator (model) that estimates losses.
- Web site for display of loss data by cereal for each country and each province, in tables and in maps. These can be aggregated to give country and regional estimates.
- Downloadable calculator for PHL estimation at any geographical scale.



www.phlosses.net

PHL estimates in both maps and tables

Estimated Post Harvest Losses (%) 2003 - 2009

for Maize in : Malawi

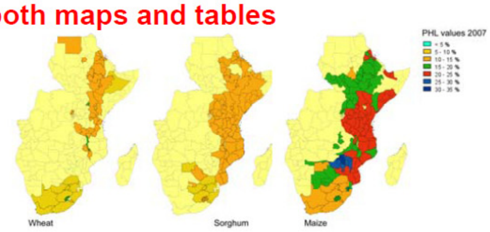
Provinces of Malawi

Please sent your comments to R.J.Hodges@gre.ac.uk

Province	2003	2004	2005	2006	2007	2008	2009
Area under National Administration	-	20.5	20.5	20.6	19		
Central Region	-	20	20	20.1	19.3	-	-
Northern Region	-	20.8	20.9	21	20.8	-	-
Southern Region	-	20.5	20.5	20.8	19.8	-	-

Click on one of these figures to get details of the loss calculation

Tables display provincial PHL estimates. Figures are hyperlinked to detailed calculations, including references to data sources and assessments of data quality.



Variation in PHLs by province for 3 cereals types. Other cereals maps presented in APHLIS are millet, rice and barley.

Key features for the user

APHLIS users get a lot more than just static PHL figures:

- APHLIS offers a downloadable version of the loss calculator as an Excel spreadsheet. Users can change default values to those relevant to their situation and generate PHL estimates for any geographical scale.
- APHLIS PHL tables can be 'clicked' to reveal a complete breakdown of the loss calculation, the sources of data and an appraisal of the quality of the data used. Users can subject PHL estimates to critical examination.
- APHLIS is easily upgraded as more reliable loss data become available. Users can contribute their loss data and, if it can be demonstrated to be better than existing data, will be added to the database.
- APHLIS will be updated annually. Users will be able to see trends in PHL data across years.

Future development and other uses

APHLIS offers a robust system to estimate PHLs, is transparent in operation and can capture improvements in loss estimates. It promises to achieve more accurate loss estimates. For the future there will be -

- A drive to improve the accuracy of the APHLIS by generating more losses data at various links in the postharvest chain.
- An expansion of the technical content to include beans and wider geographical range, e.g. W. Africa, Asia and C. & S. America
- Forecasting, for example as climate change makes unseasonal climatic events more common, new data on how these events affect postharvest losses at one location can be included in the model so that future impacts on a wider geographical range can be predicted.
- Coordination with other PHL systems/ projects e.g. WB, UNIDO, FAO…

ASARECA Transforming Agriculture for Improved Livelihoods — Natural Resources Institute — MARS JRC European Commission — Federal Office for Agriculture and Food ISICAD.org — SADC

Annex 3 Strategic note for the sustainable operation of APHLIS

Content

1. Introduction

This note is prepared in the context of the Complementary activities and follow up of the Post Harvest Losses Study: “Post harvest losses database for Food Balance Sheet operations”

The note provides a concept and work-program that contributes to sustainable long-term implementation of APHLIS. This note refers to the following paragraph of the technical tender:

For long-term sustainability APHLIS would have to be hosted on the server(s) of large international organisation(s) with a commitment to lead and foster the network of experts. To encourage such commitment and to lay the foundations to this, the project will prepare a Strategic Note that outlines a method of implementation (installation) and details likely running costs.

APHLIS comprises a database, a loss estimation model and an information management system that receive key data from a network of local experts in East and Southern Africa. APHLIS generates estimated ranges for post harvest losses in the countries and provinces of sub-Saharan Africa with a focus on the IGAD (Intergovernmental Authority on Development) and SADC (Southern African Development Community) regions. The system developed is much more than the simple database that was originally foreseen in the initial terms of reference, and includes:

- An information management system of agricultural statistics with a loss estimation model, much more interactive, responding to a number of queries about the loss ranges for countries, provinces (>200), crops, agro-climatic areas, seasons and farming systems. Alternative ranges are offered to take account of extreme climatic events, such as rainfall at time of harvest, and particular pest problems such as the larger grain borer (LGB).

- And a web base system, allowing easy access by stakeholder and inputs by present (ASARECA and SADC) or future contributing networks.

APHLIS –

- presents loss figures for the major cereal grains of each country and by closer interrogation will give the losses by crop in each province.
- traces the data source and means of calculation
- provides, on start up of the system, estimates for the losses sustained in 2007 based on data gathered by a network of local experts and on data from the literature. The online database behind the frontend will enable future data entry where circumstances have changed to give a new estimate of losses.
- will also provide tables with row-data that was provided by members of the network and thematic maps to illustrate clustering of the provinces and the special distribution of key variables such as LGB and risk of flooding.

2. Approach

It is proposed to institutionalise an Annual Meeting of APHLIS board, which submits one report per year and highlights PHL information, which was identified as relevant for decision makers. The meeting allows to address different issues:

1. An annual meeting gives importance to the results published through an official board
2. The patronage for the event is provided by JRC and therefore is attractive to stakeholders
3. The meeting is an incentive for data holders to provide data, as participation is granted, if data is available.
4. Hypothesis: it is easier to acquire funding for travels / workshops, than for “network management”. It is also easier to share these costs among donors.
5. The *A*PHLIS consists of data providers, scientists, policy makers and donors, which all contribute towards the concept of information management and PHL estimation/calculation.
6. Share new scientific evidence that might contribute to the quality of the loss estimates and information products provided by *A*PHLIS
7. Planning of work
8. Review collaborative agreement

The following workpackages will be described in the following:

1. Annual Meeting of the PHLosses board
2. Assure periodic updating of data
3. Systems development
4. Information dissemination

3. Workpackage 1: Annual Meeting of the PHLosses board

At the annual meeting, APHLIS members will present their data in the light of PHL calculations provided by the internet platform www.phlosses.net . Data providers can discuss their data and prepare them for publication in the official annual PHLosses report. In addition network members will plan activities and prepare a proposal for the next year, which will be submitted to different donors.

3.1. Elaborate the agenda and identify stakeholders for the Annual APHLIS Meeting.

Define interest groups and their interests. Identify synergies with existing key players. Invite participants to participate in the preparation of the Annual PHLosses meeting.

3.2. Acquire funding for Annual Meeting and PHL information network.

Basket funding is proposed to assure financial support of the initiative. This funding approach will contribute to an active involvement of donors and policy makers. A proposal for the organisation of the Annual PHLosses Meeting will be presented to different donors. The donors will be asked to contribute funding to organise the Annual PHLosses Meeting.

3.3. Define TORs for the participation at the annual meeting

The participation at the Annual Meeting is open to data providers, decision makers and donors. The TORs for the participation define the different roles of the participating actors. Data providers will be asked to provide in advance the required data, to comment the findings and to report on national relevant developments. Decision makers will be asked to present their expectance towards APHLIS and define how information will have an impact on decision making. Donors will present their expectations and options for support.

3.4. Annual PHL Workshop(s) with all network members

This activity comprises preparation of the agenda, logistical organisation of the meeting and identification of participants and official invitation of relevant actors. The annual workshop will be held in the sub-regions.

3.5. Annual Report

The annual report will be submitted two months after the Annual APHLIS meeting. The report will present the main findings of APHLIS.

3.6. Plan of work

The plan of work will define the scope and scale of data collection for the subsequent period.

4. Workpackage 2: Periodic updating of data

This workpackage comprises the assurance of an operational information network. An APHLIS Network Agreement defines the functions of all members. The accomplishment of the activities and the definition of new activities will be jointly discussed at the annual meeting. It is proposed that workpackage 2 will comprise the following tasks:

4.1. Negotiate and accomplish APHLIS Network Agreement

4.2. Nominate regional coordinators (IGAD and SADC)

4.3. Backstopping to facilitate data entry and management

4.4. Identify data contributors that will provide thematic data

4.5. Data acquisition and data entry

4.6. Supervision of data collection by sub-regional partners

5. Systems development

5.1. Conception frontend

Review options for data processing and presentation of factual data to facilitate informed decision making.

5.2. Conception backend

Optimise database and backend according to the elaborated procedures for PHL assessment and lessons learnt during data collection

5.3. Programming

5.4. Hosting and maintenance of the system

6. Objectives beyond PHL

APHLIS is a unique system not only in term of content but also because of the network that supports data gathering and quality management. The decentralised system allows for shared ownership and responsibility and is in deed a practical example of regional integration. It therefore has the potential to be the starting point for a system for sharing of agricultural and rural development data in general. Some points that could be considered while exploring the potential future development of the system are:

- Extend thematic scope
- Extend functionalities
- Link and exchange with other systems
- Increase the relevance of the system for rural communities

7. Calendar of planned events

WP	Tasks	2010 Jan - June	2010 July - Dec.	2011 Jan - June	2011 July - Dec.
Annual Meeting of the PHLosses board	Elaborate the agenda and identify stakeholders for the Annual APHLIS Meeting	x			
	Acquire funding for Annual Meeting and PHL information network	x		p	
	Define TORs for the participation at the annual meeting	x			
	Negotiate and accomplish Network Agreement	x			
	Annual PHL Workshop(s) with all network members	x		p	
	Annual PHL Workshop(s) participation NRI, ISICAD, JRC				
	Annual Report		x		p
Periodic updating of data	Nominate regional coordinators (IGAD and SADC)	x		p	
	Backstopping to facilitate data entry and management	x	x	p	p
	Identify data contributors that will provide thematic data	x		p	
	Data acquisition and data entry		x		p
	Supervision of data collection by sub-regional partners	x	x	p	p
Systems development	Conception frontend		x	p	p
	Conception backend		x	p	p
	Programming		x	p	p
	Hosting and maintenance of the system		x	p	p

x	Planned and calculated into budget proposal
p	Planned, but not part of budget

8. Costs

Summary

Actors	Contribution
BLE	19.200,00 €
DONOR	118.800,00 €
NRI/BLE	6.400,00 €
Network	800,00 €
<u>TOTAL</u>	**<u>145.200,00 €</u>**

Required external funding per annual meeting

Personnel	34.300,00 €
Travel	62.500,00 €
Network costs	22.000,00 €
Subtotal	**<u>118.800,00 €</u>**

Inkind contribution

BLE	19.200,00 €
NRI/BLE	6.400,00 €
Network	800,00 €
Subtotal	**<u>26.400,00 €</u>**

Detailed cost table

WP	Tasks	Cost calculation Unit (no. man days)	Unit cost	Costs	Contributions and items Potential Contributor (NRI, BLE, JRC, Other, ?, Network)	Cost items of external funding (Travel, personnel)
Annual Meeting of the PH Losses board	Elaborate the agenda &identify stakeholders for the Annual APHLIS Meeting	1	800	800 €	Donor	Personnel
	Acquire funding for Annual Meeting and PHL information network	8	800	6.400 €	NRI/BLE	
	Define TORs for the participation at the annual meeting	2	800	1.600 €	Donor	Personnel
	Negotiate and accomplish Network Agreement	2	800	1.600 €	Donor	Personnel
	Annual PHL Workshop(s) with all network members	35	1500	52.500 €	Donor	Travel
	Annual PHL Workshop(s) participation NRI, ISICAD, JRC	5	2000	10.000 €	Donor	Travel
	Annual Report	5	800	4.000 €	Donor	Personnel
Periodic updating of data	Nominate regional coordinators (IGAD and SADC)	1	800	800 €	Network	
	Backstopping to facilitate data entry and management	5	800	4.000 €	Donor	Personnel
	Identify data contributors that will provide thematic data	2	800	1.600 €	Donor	Personnel
	Data acquisition and data entry	20	1000	20.000 €	Donor	Network costs
	Supervision of data collection by sub-regional partners	2	1000	2.000 €	Donor	Network costs
Systems development	Conception frontend	12	800	9.600 €	BLE	

	Conception backend	12	800	9.600 €	BLE	
	Programming	24	800	19.200 €	Donor	Personnel
	Hosting and maintenance of the system	1	1500	1.500 €	Donor	Personnel

Annex 4: Calculation fact sheet and data sources display – generated from provincial loss figure

Post Harvest Losses Information System

- Home
- Losses estimates
- Losses map (interactive)
- Literature
- Downloads
- PHL Network
- About us Contacts Links
  - Production
  - Yield
  - Larger grain borer
  - Average farm size
  - Population
  - Rainfall
  - Max temperature
  - Min temperature
  - Rainy days
  - Risk of flooding
  - Extreme climatic events
- Login

Estimated Post Harvest Losses (%) 2003 - 2010

for Maize in : Zambia

Provinces of Zambia

Click on a loss figure in the table below to see in detail how the figure was derived. Send us your comments if you have the feeling that the underlying data and assumptions could be improved.

Please sent your comments to info(at)phlosses.net.

Back

Province	2003	2004	2005	2006	2007	2008	2009	2010
Central	-	-	-	-	-	-	-	-
Copperbelt	-	17.9	16.1	18.3	16.5	-	-	-
Eastern	-	17.2	17.1	21	16.8	-	-	-
Luapula	-	21.1	20.7	17.1	17.1	-	-	-
Lusaka	-	-	18.5	15.3	15.3	-	-	-
Northern	-	-	-	-	-	-	-	-
North-Western	-	-	-	-	-	-	-	-
Southern	-	-	-	-	-	-	-	-
Western	-	-	-	-	-	-	-	-

Back

By double clicking loss figures in the table above, the full loss calculation will be displayed. The example given below is for on the 16.8% weight loss for Eastern province in the 2007.

Calculation matrix documenting the PH loss calculation, quality of data sources and references to sources

Country : Zambia
Province : Eastern
Climate : Humid subtropical climate (Cwa)
Year : 2007
Crop : Maize

Annual production and losses		
	tonne	%
Production	225178	100
Grain remaining	187347	83.2
Lost grain	37831	16.8

Seasonal production and losses							
Season	Farm Type	Production (t)	Remaining (t)	Losses (t)	Production (%)	Remaining (%)	Losses (%)
1	small	221138	183794	37344	98.2	81.6	16.6
1	large	4040	3553	487	1.8	1.6	0.2
Seasonal:		225178	187347	37831	100.0	83.2	16.8

NB Annual averages are a weighted average of the seasons

PHL (%) Calculation

PHL (%) Calculation: Season: 1 Farm Type: *small*					
Marketed at harvest (%)	22	*If data is missing **(no data)** it is assumed that for subsistence farmers all grain is stored whereas for commercial farmers all grain is marketed.* *Note: Figures in this table are farm type specific (small or large farms). The value **Marketed at harvest (%)** is used to determine the percentage of total production that is stored and marketed by this type of farms in this particular season (Season 1, Season 2 etc). The calculation only considers the portion that is produced by this type of farm. Consequently, the figures below for **Stored (%)** and **Marketed (%)** will only add up to 100% if all grain in a particular season is produced on this farm type. Otherwise the corresponding percent figures for the other farm type, in the same season, must be included to arrive at a sum of 100%.*			
Rain at harvest	no data	*If weather is damp at harvest, leading to exceptional mould damage to the crop, then the value is **yes** and the **Harvesting/field drying** losses figure in the PHL profile is replaced by **16.3%**.*			
Storage duration (months)	no data	*Effect of storage duration:* *1. 0-3 months % figure for storage is 0 (zero)* *2. 4-6 months the % figure of the PHL profile is devided by 2* *3. more then 6 months or in case of missing data (no data) the % figure in the general profile is used*			
Larger Grain Borer	no	*If the crop is **maize** and the value is **yes** then the **Farm storage** loss figure in the PHL profile is multiplied by **2**.*			
	Destination	**Stored (%)**		**Marketed (%)**	
		76.6		**21.6**	
Stages	PHL profile (adjusted)	Remaining grain	Loss increment	Remaining grain	Loss increment
Harvesting/field drying	6.4	71.7	4.9	20.2	1.4
Platform drying	4	68.8	2.9	19.4	0.8
Threshing and Shelling	1.2	68	0.8	19.2	0.2
Winnowing	-	68	0	19.2	0
Transport to farm	2.3	66.4	1.6	19.2	0
Farm storage	4.5	63.4	3	19.2	0
Transport to market	1	63.4	0	19	0.2
Market storage	4	63.4	0	18.2	0.8
Total		**63.4**	**13.2**	**18.2**	**3.4**

NB Figures related to % storage and % marketing are adjusted for seasonal production. So if for example small farms market 22% of their harvest and they are responsible for 98.2% of the total season's production, the remainder coming from large commercial farmers, then small farms are actually marketing 21.6% of the total season's production (22 x 0.982). Likewise if they are storing 78% of their production then they would be storing 76.6% of the total season's production (78 x 0.982).

PHL (%) Calculation: Season: 1 Farm Type: *large*					
Marketed at harvest (%)	89	*If data is missing **(no data)** it is assumed that for subsistence farmers all grain is stored whereas for commercial farmers all grain is marketed.* *Note: Figures in this table are farm type specific (small or large farms). The value **Marketed at harvest (%)** is used to determine the percentage of total production that is stored and marketed by this type of farms in this particular season (Season 1, Season 2 etc). The calculation only considers the portion that is produced by this type of farm. Consequently, the figures below for **Stored (%)** and **Marketed (%)** will only add up to 100% if all grain in a particular season is produced on this farm type. Otherwise the corresponding percent figures for the other farm type, in the same season, must be included to arrive at a sum of 100%.*			
Rain at harvest	no data	*If weather is damp at harvest, leading to exceptional mould damage to the crop, then the value is **yes** and the **Harvesting/field drying** losses figure in the PHL profile is replaced by **16.3%**.*			
Storage duration (months)	no data	*Effect of storage duration:* *1. 0-3 months % figure for storage is 0 (zero)* *2. 4-6 months the % figure of the PHL profile is devided by 2* *3. more then 6 months or in case of missing data (no data) the % figure in the general profile is used*			
Larger Grain Borer	no	*If the crop is **maize** and the value is **yes** then the **Farm storage** loss figure in the PHL profile is multiplied by **2**.*			
	Destination	**Stored (%)**		**Marketed (%)**	
		0.2		**1.6**	
Stages	PHL profile (adjusted)	Remaining grain	Loss increment	Remaining grain	Loss increment
Harvesting/field drying	2	0.2	0	1.6	0
Platform drying	3.5	0.2	0	1.5	0.1
Threshing and Shelling	2.3	0.2	0	1.5	0
Winnowing	-	0.2	0	1.5	0
Transport to farm	1.9	0.2	0	1.5	0
Farm storage	2.1	0.2	0	1.5	0
Transport to market	1	0.2	0	1.5	0
Market storage	4	0.2	0	1.4	0.1
Total		**0.2**	**0**	**1.4**	**0.2**

NB Figures related to % storage and % marketing are adjusted for seasonal production. So if for example large farms market 89% of their harvest and they are responsible for 1.8% of the total season's production, the remainder coming from small farmers, then large farms are actually marketing 8% of the total season's production (89 x 0.018). Likewise if they are storing 11% of their production then they would be storing 0.2% of the total season's production (11 x 0.018).

Data quality display and references to sources

PHL profiles are used to calculate losses, each profile consists of a series of values, one for each link in the postharvest chain. Each value in the PHL profile is formed from the average of several figures drawn from the available literature. All these figures are shown individually in the tables below. Separate PHL profiles are given for small farms and large (commercial) farms. The reliability of each datum contributing to the calculation of each PHL profile value is assessed in the table below according to how specific it is to the situation in which it is being used. It assessed with respect to whether it is the same 'Cereal' (Maize, rice etc), 'Climate' (is from a climate with the same Koeppen code), 'Farm' (from a small farm or large commercial farm), and if the 'Method' used involved actual measurement or was a questionnaire survey or guesstimate. The result of the assessment is indicated using the 'red/0' and 'green/1' system as follows –

0	A datum used in the calculation of a PHL profile value is not specific to this situation or is from a questionnaire survey or a guesstimate, i.e. is not measured.

1	A datum used in the calculation of a PHL profile value is specific to this situation or is measured.

PHL profile figures based on more green/1 data are considered to be more reliable than those based on more red/0 data. Against each PHL profile value the number of 'red/0' and 'green/1' assessments is averaged, and displayed in bold, to give a general assessment of the value. Frequently some parts of the profile are more reliable than others, especially those where more loss data are available from the literature.

PHL profile: Data quality display and references to sources

*PHL profiles are used to calculate losses, each profile consists of a series of values, one for each link in the postharvest chain. Each value in the PHL profile is formed from the average of several figures drawn from the available literature. All these figures are shown individually in the tables below. Separate PHL profiles are given for small farms and large (commercial) farms. The reliability of each datum contributing to the calculation of each PHL profile value is displayed in the table below. The assessment is based on how specific the figure is to the situation in which it is being used. To do this, each figure is assessed according to whether it is from the same **Cereal** type (maize, rice etc), same **Climate** type (is from same Koeppen code), same **Farm type** (from a small farm or large commercial farm), and if the **Method** of loss assessment was an actual measurement of loss or was a questionnaire survey or guesstimate. The result of the assessment is indicated using the **red/0** and **green/1** system as follows -*

0	*A datum used in the calculation of a PHL profile value is not specific to this situation or is from a questionnaire survey or a guesstimate, i.e. is not measured.*

1	*A datum used in the calculation of a PHL profile value is specific to this situation or is measured.*

*PHL profile figures based on more **'green/1'** data are considered to be more reliable than those based on more **'red/0'** data. Against each PHL profile value the number of **'red/0'** and **'green/1'** assessments is averaged, and displayed in bold, to give a general assessment of the value. Frequently some parts of the profile are more reliable than others, especially those where more loss data are available from the literature.*

References and individual loss figures % for small farms						
			Origin of figure			
Stages	Loss figure	Reference	Cereal	Climate	Farm type	Method
	2.0	Boxall R.A. - 1998	0	0	1	0
	9.9	Grolleaud M. - 1997	1	0	1	0
	5.8	Mvumi B.M. - 1995	1	1	1	0
	9.5	Odogola W.R. - 1991	1	1	1	0
	5.0	Vervroegen D. - 1990	0	1	1	0
Harvesting/field drying	**6.4**		**1**	**1**	**1**	**0**
	3.5	Lars-Ove Jonsson - 1987	1	1	1	0
	4.5	Odogola W.R. - 1991	1	1	1	0
Platform drying	**4.0**		**1**	**1**	**1**	**0**
	1.0	Boxall R.A. - 1998	0	0	1	0
	0.3	Grolleaud M. - 1997	1	0	1	0
	2.5	Mvumi B.M. - 1995	1	1	1	0
	1.0	Odogola W.R. - 1991	1	1	1	0
Threshing and Shelling	**1.2**		**1**	**1**	**1**	**0**
	2.0	Boxall R.A. - 1998	0	0	1	0
	2.0	Singano C. - 2008	1	1	1	0
	2.0	Singano C. - 2008	1	1	1	0
	2.3	Singano C. - 2008	1	1	1	0
	4.0	Singano C. - 2008	1	1	1	0
	1.0	Odogola W.R. - 1991	1	1	1	0
	3.0	Vervroegen D. - 1990	0	1	1	0
Transport to farm	**2.3**		**1**	**1**	**1**	**0**
	4.1	Adams J.M. - 1977	1	1	1	1
	5.4	Adams J.M. - 1977	1	1	1	1
	4.3	Binder K.F. - 1994	1	1	1	1
	4.4	Binder K.F. - 1994	1	1	1	1
	4.6	Binder K.F. - 1994	1	1	1	1
	4.4	Binder K.F. - 1994	1	1	1	1
	4.4	De Lima C.P.F. - 1982	1	1	1	1
Farm storage	**4.5**		**1**	**1**	**1**	**1**
	1.0	Odogola W.R. - 1991	1	1	1	0
Transport to market	**1.0**		**1**	**1**	**1**	**0**
	4.0	Boxall R.A. - 1998	0	0	1	0
Market storage	**4.0**		**0**	**0**	**1**	**0**

On the website, users can hold the cursor over each reference in the tables to reveal the full bibliographical details. For example, in the table above holding the cursor over 'Boxall R.A. – 1998, the following box would appear.

References and individual loss figures % for large farms						
			Origin of figure			
Stages	Loss figure	Reference	Cereal	Climate	Farm type	Method
Harvesting/field drying	2.0	Boxall R.A. - 1998	0	0	1	0
	2.0		**0**	**0**	**1**	**0**
Platform drying	3.5	Lars-Ove Jonsson - 1987	1	1	1	0
	3.5		**1**	**1**	**1**	**0**
Threshing and Shelling	1.0	Boxall R.A. - 1998	0	0	1	0
	3.5	Odogola W.R. - 1991	1	1	1	0
	2.3		**1**	**1**	**1**	**0**
Transport to farm	2.0	Boxall R.A. - 1998	0	0	1	0
	0.5	Singano C. - 2008	1	1	1	0
	2.0	Singano C. - 2008	1	1	1	0
	2.1	Singano C. - 2008	1	1	1	0
	3.0	Singano C. - 2008	1	1	1	0
	1.9		**1**	**1**	**1**	**0**
Farm storage	1.7	Singano C. - 2008	1	1	1	0
	2.5	Singano C. - 2008	1	1	1	0
	2.1		**1**	**1**	**1**	**0**
Transport to market	1.0	Odogola W.R. - 1991	1	1	1	0
	1.0		**1**	**1**	**1**	**0**
Market storage	4.0	Boxall R.A. - 1998	0	0	1	0
	4.0		**0**	**0**	**1**	**0**

Annex 5: Recommendations for the development of a 'Manual for assessing postharvest cereal losses'

Introduction

Reliable estimates for postharvest weight losses are needed for at least three purposes: planning and prioritizing loss reduction programmes, guiding the development of agricultural policy, and for the calculation of cereal supply/demand balances of developing countries. The food crisis of 2007/2008 has renewed international interest in the reduction of postharvest losses, as a means of increasing food availability while conserving the resources already expended on food production such as labour, water, land and agricultural inputs. Currently, the African Development Bank and World Bank are both considering new and substantial initiatives on postharvest loss reduction for cereals in Sub-Saharan Africa (SSA). Consequently, reliable data on postharvest losses are becoming more ever more important.

The only readily available source of postharvest loss data for cereals in SSA is the African Postharvest Losses Information System (APHLIS) that consists of a web based information system and a network of local experts. During the development of APHLIS it became clear that good data on losses were scarce and that the performance of the system is in part constrained by this. Since the 1970s, efforts have been made to assess the grain losses suffered by African farmers. Most measured estimates of loss have been of grain stored on farm; little data have been generated on other links in the postharvest chain such as harvesting, drying, threshing/winnowing, transport or market storage. For farm storage losses, APHLIS relies on about 70 measured figures to cover seven types of cereal under several climate types for both smallholder and large commercial production. Few if any of the data on other links in the postharvest chain are measured, instead they have been mostly derived from questionnaire surveys (of uncertain quality) or are just guesstimates. Data on PHLs associated with one key variable, cloudy/damp weather at harvest, are limited to a single measured value, yet it is expected that increased variability of weather conditions due to climate change will make harvesting under this conditions more common in some areas.

In response to this situation, the APHLIS network should be encouraged to collect loss data that are compatible with APHLIS. This can be achieved by creating an instruction manual on loss assessment that will

- be used by the APHLIS network (and others) so that in the future there will be uniformity and consistency of data collection
- give reasonable confidence in the accuracy of data
- optimize data supply, given constraints of time and money,
- draw attention to those data that are most in need, and
- provide a lead in loss assessment that will encourage participation in APHLIS and a stronger focus on loss reduction opportunities.

The APHLIS system expresses losses as the cumulative loss in weight of cereal grains from production, but also provides loss figures for each link in the postharvest chain and takes account of a variety of factors that affect the chain. Although APHLIS was originally developed to assist in the calculation of cereal supply estimates, it has much wider applications. The key issue for cereal supply calculations is food availability. During postharvest operations there may be losses of both cereal quantity and quality but what is of concern is loss of quantity (weight loss). The reason for this is that if, after a quality change, cereals are still fit for human consumption then there has been no loss in food availability. Losses during food processing (milling etc) are not included in the calculation, although such processes may be an important target for loss reduction programmes. Loss assessment by APHLIS therefore focus on harvesting of grain then along the postharvest chain as far as market or central storage.

Existing approaches to assessment of cereal PHLs

Modern approaches to loss assessment of cereals were detailed in the late 1970s (Harris and Lindblad, 1978; National Academy of Sciences, 1978), fuelled by interest in loss reduction following the food crisis of the mid-1970s. Subsequently, these approaches, including most of main links in the postharvest chain, were reviewed critically by Boxall (1986). Meanwhile, problems with larger grain borer, a pest of stored maize in Africa, lead to an intensification of postharvest project activity at farm level, and further appraisal of loss assessment, especially rationalisation of the intrinsic value of loss figures and the options for adopting rapid approaches (Wright, 1995; Compton and Sherington, 1999).

What will the manual be like?

The manual,designed specifically for use with APHLIS, will be a simple guide to the estimation of PHLs with illustrations and examples lightening the text,. It will offer non-measurement and measurement options for loss assessment and describe the resources required and the drawbacks associated with the methods.

The manual will provide an approach to estimating losses for the cereals maize, wheat, rice, sorghum and millet at the following links in the postharvest chain

Harvesting
Drying
Shelling/threshing
Farm storage
Transport to market
Market storage

The main elements of the approach should be

1) **Participatory rural appraisal** (PRA) to gather an understanding from farmers/households/traders about the location and scale of losses. There should be a description of the approach to take and a checklist of questions to ask. The method is reliant on additional questioning and cross checking, and how this is done and recorded should be explained. Considerable emphasis is needed on how to make meaningful quantitative estimates by this approach, i.e. establish with the interviewee a unit of cereal weight, and how many of these units are lost. Loss assessment for many situations would have to be confined to this approach due to lack of time/funds.
2) A description of how to implement **rapid loss assessment methods** for grain storage, in particular visual scales, the calibration of scales, relating scales to end use and grain sampling. A description is need of when the assessment should be made and how it is corrected for farm consumption and sales.
3) A description of loss assessment for other links in the chain (except farm storage).
4) A description of data recording and submission of results to APHLIS.

What activities are needed to develop the PHL manual?

Much of the proposed approach can be taken directly from the literature and synthesised into a loss assessment methodology appropriate to APHLIS. Some inspiration can be taken from the approach used by FAO for loss assessment in postharvest fisheries (Ward and Jeffries, 2000), although approaches such a ‘load tracking’ may be impractical with cereals and a complete calculation of loss is not required since data for the relevant links in the chain can be submitted to APHLIS for the calculation of a cumulative weight loss.

An essential component in the development of the manual would be some field work at an African location. This is needed to refine the checklist of questions to ask for the PRA, create illustrative photographs to accompany the text for grain sampling and visual scale development and for the assessment methods for other links in the chain.

The final version of the manual would be available as a download from the APHLIS website; it is not anticipated as a printed hard copy.

Outline budget/resources need for the manual

Item	Man days	Cost
Writing text	15	€9,000[1]
Field testing and gathering illustrations	12	€7,200
Travel costs Airfare to African location Per diem for 10 days		 €1,500 €1,000[2]
Local support costs Field transport Staff fee for 2 local staff	 20	 €1,000 €2,000[3]
	Total	€21,700

[1]Assuming fee rate of €600/day [2]Per diem €100/day [3]Assuming fee rate of €100/day

Tentative table of contents for the losses manual

1. What are cereals postharvest losses
    a. The nature of cereals postharvest losses for cereals (with illustrations)
    b. The balance should there be between sample size and accuracy of individual measures
    c. What is APHLIS and how does it work
2. The need for PHL weight loss data for APHLIS
    a. What type of data does APHLIS need
    b. What are the most important gaps in APHLIS data
    c. How can data be submitted to APHLIS
3. A general approach to generating new data on PHLs
    a. Importance of knowing the local situation
    b. The interview survey as a basis to loss assessment
    c. How losses can be measured and the advantages of rapid techniques
    d. Cross referencing between questionnaire data and measured losses
4. How to undertake participatory rural appraisal (PRA) for loss estimation
    a. Identifying the place to survey
    b. Interacting with the farmer/households and choosing who should be interviewed and how many
    c. Conducting the interview
    d. The kinds of questions to ask and maximising quantitative information
5. How to undertake rapid loss assessment in farm stores using visual scales
    a. Construction and calibration of visual scales
    b. Validation of visual scales and reference to end use
    c. Grain sampling procedures
    d. Allowing for consumption patterns in loss estimates
6. How to undertake measured assessment of losses in other areas of the postharvest chain
    a. Harvesting
    b. Drying
    c. Winnowing/shelling
    d. Transport
    e. Market and large scale storage
7. Planning loss assessment and the resources needed
    a. The best time to do the assessment
    b. Sources of information in support of the assessment
    c. Equipment needed
    d. Staffing needs
    e. Budgeting for an assessment – what to include

Annex 1 – Suggested outline questionnaire on which to base a loss assessment PRA

References

Boxall R.A. (1986) A critical review of the methodology for assessing farm-level grain losses after-harvest. Natural Resources Institute, Chatham Maritime, Kent ME4 4TB, UK. Report G191, pp 139.

Annex 6: Storage weight losses

Weight loss % during storage of cereal crops, original estimates, estimates standardized for 9-month storage period and an even household consumption pattern, arranged by country and prevailing climate classification (Köppen code) and with an indication of the quality of the data source

Country	Climate code	Farming scale	Original estimate	St'ized estimate	Quality rating	Authors
Maize cob storage with LGB						
Tanzania	Aw	small	**34.0**	**11.6**	M	Golob and Boag 1985
Tanzania	Aw	small	**20.0**	**7.8**	M	Hodges et al. 1983
Tanzania	Aw	small	**31.0**	**11.6**	M	Henkes 1992
Malawi	BSh/Aw	large	**8**	**2.7**	Q/G	Singano (pers. comm.)
Malawi	BSh/Aw	large	**8**	**2.7**	Q/G	Singano (pers. comm.)
Malawi	BSh/Aw	small	**40**	**13.7**	Q/G	Singano (pers. comm.)
Malawi	BSh/Aw	small	**38**	**12.9**	Q/G	Singano (pers. comm.)
Malawi	Cwa	large	**5**	**1.7**	Q/G	Singano (pers. comm.)
Malawi	Cwa	large	**7**	**2.5**	Q/G	Singano (pers. comm.)
Malawi	Cwa	small	**41**	**13.8**	Q/G	Singano (pers. comm.)
Malawi	Cwa	small	**35**	**11.1**	Q/G	Singano (pers. comm.)
Tanzania	Cwb/Aw	small	**5.1**	**5.1***	M	Ashimogo 1995
Maize cob storage no LGB						
Ethiopia	Aw	small	**8.0**	**5**	Nk	SSEAD 1997
Kenya	Aw	small	**5.2**	**4.6**	M	Nyambo 1993
Kenya	Aw	small	**7.28**	**7.28***	Mu	De Lima 1979
Kenya	Aw	small	**6.23**	**6.23***	Mu	De Lima 1979
Kenya	Aw	small	**15.0**	**6.1**	M	Giles 1986b
Kenya	Aw	small	**4.58**	**4.58***	Mu	De Lima 1979
Kenya	Aw	small	**8.5**	**3.1**	M	Giles 1986b
Kenya	Aw	small	**5.22**	**5.22***	Mu	De Lima 1979
Tanzania	Aw	small	**1.9**	**1.9***	M	Bengstsson et al. 1991
Kenya	BSh	small	**6.16**	**6.16***	Mu	De Lima 1979
Malawi	BSh/Aw	small	**4.5**	**2.4**	M	Golob 1981 a
Malawi	Cwa	small	**7.58**	**4.4**	M	Binder et al 1994
Malawi	Cwa	small	**7.73**	**4.3**	M	Binder et al 1994
Malawi	Cwa	small	**8.9**	**4.6**	M	Binder et al 1994
Malawi	Cwa	[1]small	**39.8**	**9.5**	Mu	Schulten and Westwood 1972
Malawi	Cwa	[2]small	**6.7**	**1.6**	Mu	Schulten and Westwood 1972
Malawi	Cwa	[3]small	**3.6**	**0.9**	Mu	Schulten and Westwood 1972
Malawi	Cwa	small	**2.1**	**1.2**	M	Golob 1981 b
Swaziland	Cwa	small	**4.05**	**4.4**	M	De Lima 1982
Zambia	Cwa	small	**9.0**	**4.1**	M	Adams 1977
Zambia	Cwa	small	**13.0**	**5.4**	M	Adams 1977
Varieties [1] hybrid, [2] improved [3] local			* household consumption included in original estimate			
Maize grain with LGB						
Tanzania	Aw	small	**19.7**	**7.6**	M	Golob and Boag 1985

Tanzania	Aw	small	**8.0**	**3.3**	M	Henkes 1992
Maize grain no LGB						
Ethiopia	Aw	small	**9.0**	**5.5**	Nk	SSEAD 1997
Kenya	Aw	small	**18.0**	**7.8**	M	Giles 1986b
Kenya	Aw	small	**14.1**	**5.4**	M	Giles 1986b
Kenya	Aw	small	**14.0**	**5.3**	M	Giles 1986b
Zambia	Cwa	small	**2.6**	**0.9**	M	Adams 1977
Zimbabwe	Cwa	small	**7.01**	**7.01***	M	Keterere & Giga 1990
Zimbabwe	Cwa	small	[1]**12.2**	**12.2***	M	Keterere & Giga 1990
Ethiopia	Cwa	small	**2.56**	**0.8**	Nk	Kidane and Habteyes 1989
Sorghum threshed						
Eritrea	BWh/BSh	small	**14.89**	**5.5**	M	Haile 2006a
Eritrea	BWh/BSh	small	**12.99**	**5.7**	M	Haile 2006a
Sudan	BWh/BSh	small	**5.32**	**2.5**	M	Seifelnasr 1992
Sudan	BWh/BSh	small	**5**	**2.4**	M	Seifelnasr 1992
Sudan	BWh/BSh	small	**4.25**	**2**	M	Seifelnasr 1992
Sudan	BWh/BSh	small	**3.22**	**1.5**	M	Seifelnasr 1992
Sudan	BWh/BSh	small	**3.15**	**1.5**	M	Seifelnasr 1992
Sudan	BWh/BSh	small	**2.866**	**1.4**	M	Seifelnasr 1992
Sudan	BWh/BSh	small	**2.8**	**1.3**	M	Seifelnasr 1992
Sudan	BWh/BSh	small	**1.75**	**0.8**	M	Seifelnasr 1992
Malawi	BSh/Aw	small	**10.5**	**3.5**	Q/G	Singano (pers. comm.)
Malawi	Cwa	small	**7**	**2.5**	Q/G	Singano (pers. comm.)
Malawi	Cwa	small	**10**	**3.4**	Q/G	Singano (pers. comm.)
Ethiopia	Cwa	small	**10.96**	**4.3**	Nk	Kidane and Habteyes 1989
Ethiopia	Cwa	small	**15.4**	**5.5**	Nk	Kidane and Habteyes 1990
Sorghum unthreshed						
Kenya	Aw	small	**10.2**	**4.7**	M	Nymabo 1993
Wheat						
Eritrea	BSh	small	**6.5**	**3.1**	M	Haile 2006a
Eritrea	BSh	small	**0.65**	**0.1**	M	Haile 2006a
Ethiopia	BSh	small	**0.1**	**0.1**	Nk	SSEAD 1997
Malawi	BSh/Aw	small	**0.5**	**0.5**	Q/G	Singano (pers. comm.)
Ethiopia	Cwa	small	**2.1**	**0.7**	Nk	Kidane and Habteyes 1989
Malawi	Cwa	small	**15**	**5.8**	Q/G	Singano (pers. comm.)
Barley						
Ethiopia	Cwa/Cwb	small	**2.5**	**0.9**	Nk	Kidane and Habteyes 1989
Ethiopia	Cwa/Cwb	small	**2.0**	**0.7**	Nk	Kidane and Habteyes 1989
Millet						
Namibia	BSh	small	**1.52**	**0.7**	M	Hodges et al. 2006
Malawi	BSh/Aw	small	**5**	**2.4**	Q/G	Singano (pers. comm.)
[1] Hybrid variety			* household consumption included in original estimate			
Malawi	Cwa	small	**3**	**1.3**	Q/G	Singano (pers. comm.)
Malawi	Cwa	small	**3**	**1.3**	Q/G	Singano (pers. comm.)
Rice						
Malawi	BSh/Aw	small	**0.1**	**0.1**	Q/G	Singano (pers. comm.)
Malawi	Cwa	small	**2**	**0.6**	Q/G	Singano (pers. comm.)

Malawi		small	**0.2**	**0.2**	Q/G	Singano (pers. comm.)
Teff						
Ethiopia	Cwa	small	**0.3**	**0.3**	Nk	Kidane and Habteyes 1989

Data quality rating

Measured, using modern methodology - M
Measured, methodology uncertain - Mu
Questionnaire - Q
Guesstimate - G
Not known - Nk

Köppen Climate

Aw Tropical savannah
BSh Arid steppe, hot
BWh Arid desert, hot
Cwa temperate dry winter, hot summer
Cwb temperate dry winter, warm summer

Annex 7: Store types showing different ventilation rates

Traditional stores		Modern stores

High ventilation

Restricted airflow

Airtight stores

Annex 8: National persons/teams responsible for contributing data to PH losses network

Country Team Member List 08.09.2008							
			Function in Team				
Country	First Name	Family Name	National focal point	Main contact person during data collection	Data collection	Data entry	Organisation
Angola	Silva	Domingo	no	no	yes	no	GSA-MINADER
	Ermelinda	Lahiengue	no	no	yes	no	GSA-MINADER
	Valdemar	Morais	no	yes	yes	yes	GSA-MINADER
	David	Tonga	yes	no	yes	no	GSA-MINADER
Botswana	K.	Moremedi	no	no	yes	no	Min. of Agriculture
	(Matsietsa)	Obakeng	no	no	yes	no	Min. of Agriculture
	Onkgopotsr	Ramogapi	no	no	yes	no	Min. of Agriculture
	Hange	Rebecca	yes	yes	yes	yes	Department of Crop Production
	Kehumile	Sebi-Ndlovu	no	no	yes	no	Min. of Agriculture
D.R. Congo	Bernard	Assumami	no	no	yes	no	MOA
	Mulume	Kahavi	no	no	yes	no	SNSA
	Simon	Lukombo	no	no	yes	no	INERA
	Joslim	Makoko	no	no	yes	no	INERA
	Mbeya	Mergo	no	no	yes	no	Pact-Congo
	Philippe	Ngolo	no	no	yes	no	CADIM
	Chankel	Palabina	no	no	yes	no	University of Kimshasa
	Willy	Tata-Hangy	yes	yes	yes	yes	INERA
Eritrea	Iyassu	Ghebretatios	yes	no	no	no	NARI
	Abraha	Negusse	no	yes	yes	yes	NARI
	Haile	Solome					NARI
Ethiopia	Kebede	Gashaw	yes	yes	yes	yes	Addis Ababa University
Kenya	Mutambuki	Kimondo	yes	yes	yes	yes	KARI
	P.N.	Nyaga	no	no	yes	yes	Ministry of Agriculture
Lesotho	Matsitso	Motemekoane	yes	yes	yes	yes	Disaster Mngm. Authority-NEWU
	Mokotla	Ntela	no	no	yes	no	BROA
	Thabo	Sophonea	no	no	yes	no	Bureau of Statistics
		Tongwane	no	no	yes	no	Meteorology
							Min. Agriculture
Madagascar	Jean Marie	Rakotovao	no	yes	yes	yes	CAETIC
	Auguste	Randrianiriana	yes	no	no	no	Ministere de l'Agriculture
	Adrianjafy	Rasoaninarainy	no	no	yes	yes	CAETIC
Malawi	Isaac	Kawenji Chirwa	no	no	yes	yes	Min. Agriculture and Food Security
	Hannock	Kumwenda	yes	yes	yes	yes	Min. of Economic Planning
Mauritius	Ramnauth	Raj	yes	yes	yes	yes	AREU / Min.Agric
Mosambique	Antonio Jacinto	Da Toraca	no	yes	yes	yes	Ministry of Agriculture
	Jantilale	Ititeu	no	no	yes	yes	Ministry of Agriculture
	Manuel	Jamisse	no	no	yes	no	Ministry of Commerce
	Serafina	Mangane	no	no	yes	no	Ministry of Agriculture
	Mario	Ubisse	yes	yes	yes	yes	Ministry of Agriculture

Country Team Member List 08.09.2008							
			Function in Team				
Country	First Name	Family Name	National focal point	Main contact person during data collection	Data collection	Data entry	Organisation
Namibia	Kamwi	Chaka	no	yes	yes	yes	Ministry of Agriculture
	Gerladine	Diergaardt	yes	yes	yes	yes	Ministry of Agriculture
Rwanda	David	Bucakana	no	yes	yes	yes	Ministry of Agriculture
	Christine	Mukantwali	no	yes	yes	yes	ISAR
	Madjaliwa	Nzamwita	no	no	yes	no	ISAR
	Goretti	Umvhozariho	no	no	yes	no	NUR
South Africa	Rona	Beukes	yes	yes	yes	yes	National Department of Agriculture
	Wiltrud	Durand	no	no	yes	no	ARC- GCI
	Anna	Enslin	no	no	yes	no	SA Grain Info Services
	Johan	Malherbe	no	no	yes	no	ARC- ISCW
	Marda	Scheepers	no	no	yes	no	Dept. Of Agriculture
	Queen	Sebidi	no	yes	yes	yes	Dept. Of Agriculture
Sudan	Prof. Shelkh Eldin	Afzadir Al-Wad	no	yes	yes	yes	ARC
	Prof. Abba	El Sir	no	no	yes	no	ARC
	Kannan	Hassan Omer	yes	yes	yes	yes	ARC
	Dr. Susan	M. Abdullah	no	no	yes	no	ARC
Swaziland	Vakele	Gama	no	no	yes	no	Ministry of Agriculture
	Sunshine	Gamedze	yes	yes	yes	yes	Meteorology Department
	Choice	Ginindza	no	no	yes	no	Central Statistics Office
	Majola	Mabuza	no	no	yes	no	University of Swaziland
	Ajedrge	Ndlangamandla	no	no	yes	no	Ministry of Agriculture
Tanzania		Malema	no	no	yes	no	MAFC, Crop Development
	Ntikha	Onasimbo Anderson	yes	yes	yes	yes	Min.Agric, Food & EarlyW
		Ruboha	no	no	yes	no	MAFC, Policy and Planning Division
		Urassa	no	no	yes	no	NBS, Agric. Statistics Section
	No name	No name	no	no	yes	no	Min. of Agriculture
Uganda	Ambrose	Agona	yes	yes	yes	yes	NARO-NPHP-NARL
	Eriya	Bwana Simba	no	no	yes	yes	NARL / NARO
	Evelyn	Komutunga	no	no	yes	no	NARL / NARO
	Harriet	Muyinza	no	no	yes	yes	NARL / NARO
Zambia	Dingiswayo	Banda	no	no	yes	no	Ministry of Agriculture
	Michael	Isimwaa	yes	yes	yes	yes	Ministry of Agriculture
	Masiliso	Sooka	no	no	yes	no	CSO
Zimbabwe	Gondo	Joseph	yes	yes	yes	yes	D. of Agic., Tech.,and Ext. S
		Chikwerhere	no	no	yes	no	Plant Protection Research Institute
	Danisile	Hikwa	no	no	yes	no	Dept. Of Agriculture, Research for Development
		Jasi	no	no	yes	no	Grain Marketing Board
	Karsto	Kwazira	no	no	yes	yes	AGRITEX
	Juliet	Magwenzi	no	no	yes	yes	Meteorological Dept.
		Munyati	no	no	yes	no	Dept. Of Agricultural Engineering
		Nyamukapa	no	no	yes	no	Ministry of Agric. Economics and Markets dept.

European Commission

EUR 24712 EN – Joint Research Centre – Institute for Environment and Sustainability
Title: **The African Postharvest Losses Information System (APHLIS)**
Author(s): **F. Rembold, R. Hodges, M. Bernard, H. Knipschild and O. Leo**

Luxembourg: Publications Office of the European Union
2011 – 72 pp. – 21.0 x 29.7 cm
EUR – Scientific and Technical Research series – ISSN 1018-5593
ISBN 978-92-79-19143-5
doi: 10.2788/40345

Abstract
This report explains the construction and operation of **APHLIS (The African Postharvest Losses Information System)**, a recent development in PHL estimation that provides the countries of East and Southern Africa with cereal PHL figures. These are estimated by crop, by country and by province and take into account scale of farming, climate type, number of harvests, proportion marketed etc. (Hodges et al., 2010). APHLIS was developed initially to support cereal supply calculations but may be equally useful to the other applications of PHLs estimates.

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LB-NA-24712-EN-C

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Publications Office

ISBN 978-92-79-19143-5

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