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Structured recording of data and analysis of loss in public storage system

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ABSTRACT

The storage loss has negative welfare effect on society because it curtails the supply on one hand and incurres expenditure on the other. The extent of losses varies with commodities and agro-climatic regions. In this backdrop, a systematic data recording and analysis on storage losses corresponding to the factors responsible for such losses has been undertaken in 48 depots of Food Corporation of India (FCI) and Central Warehousing Corporation (CWC) covering 13 agro climatic zones in 22 States of India. To manage enormous data, software was developed which mainly comprises of Central Data Management at Indian Council of Agricultural Research-Central Institute of Post Harvest Engineering and Technology (ICAR-CIPHET) and Local Data Management by collaborating Centres. In this paper, data entity relationship, database approach and its advantage were discussed. The developed data entry software is user friendly, efficient, systematic, well secured and avoids duplicity. It can generate the reports in desired format, which will help to recommend norms for effective management of losses in public storage system.

Key words: CWC, Database, FCI, Software, Storage losses

Storage loss reduces the amount of food which may be quantitative and/or qualitative. Food grains play a vital role in the vegetarian Indian diet. Irrespective of increasing production in food grain sector, there is still a pitfall in food and nutritional security mainly due to poor storage management. A large number of losses incur due to insects, rodents, micro-organisms and environmental conditions such as type of storage structure (Godown/CAP), temperature, relative humidity etc. which upshot the storage situation to greater extent (Sashidhar et al., 1992). The fiscal value of these losses amounts to more than ₹ 50,000 crore/ year (Singh, 2010).

In developing country like India, the production and harvest periods are relatively short, whereas, the consumption extends throughout the year. Storage provides time utility and ensures food security, price stabilization and helps in maintaining internal/external export. Above all, the indispensable objective of grain storage is to keep the grains in good condition for marketing and processing while preserving their quality and nutritive value, thereby reducing the physical and financial losses. The storage losses, however, are location as well as season specific to such an extent that makes the concept of average levels of loss sometimes inconsequential.

In the light of foregoing study, an appropriate strategy for recording data has to be viewed in its proper perspective. It must be borne in mind that the objective of developing such software is to provide methods yielding standardized results so that an effective analysis of storage study could be made.

This paper presents a Data Entry Software developed by ICAR-IASRI and ICAR-CIPHET under 'ICAR-FCI project on 'Determining losses in food grains in FCI and CWC warehouses'. Its underlying principle is based on the expansion of a database application that share data and operations through a database. Data entry software will be

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helpful for collecting periodic data from different godowns in the desired format and will generate statistical tables and MIS/Query reports for monitoring of storage losses. Moreover, the software facilitates the data entry and avoids duplication of the data. Furthermore, it is useful for FCI and CWC for analysing food grain loss/gain and factors contributing to such loss.

Database approach

A database is a group of allied files, and a database management system DBMS is the software designed to create, store and operate a database. Basically DBMS is intended to handle various individual records to execute their functions (Turban, 1993). In the developed data entry software, the provision is made for commodities such as wheat, rice, paddy, parboiled rice and maize, however, a number of commodities can be entered with some modification. The data pertaining to 48 godowns and Cover and Plinth (CAP) in India covering 22 states under 13 agro-climatic zoness (Fig. 1) and participating centres of All India Coordinated Research Project on Post-Harvest Engineering and Technology (AICRP on PHET) (Table 1) are being recorded in master sheet.

Fig. 1. Location of godown and CAP storage

In addition, there are 5 spread sheets, namely Schedules Data Entry, Report Generation/Print report, Data Analysis, Export and Add/Edit users. Under Schedule Data Entry, observation can be recorded (i) at time of procurement, (ii) fortnightly, quarterly, (iii) at the time of liquidation and (iv) environmental factor. The software was developed in visualbasic. net and Entity Relationships Diagram and Software Architecture given as Figs. 2 and 3. The architecture of data entry software consists of Local Data Management System (at collaborating centres of AICRP on PHET) and Central Data Management System (at headquarter of AICRP on PHET, ICAR-CIPHET, Ludhiana). The number of depot and stacks selected for which data to be recorded in software is given in Fig. 4.

The central coordinating unit will enter master sheet and link will be available to collaborating centres whereas, Local data management by collaborating centres will do all the schedule entries. Through import and export facility, data can be shared between local management and central management system (Fig. 3). The observations on physical and microbial quality parameters of the commodity are being recorded fortnightly and liquidation is being done at quarterly basis. Besides, environment data of the depot are recorded on daily basis. The loss/gain in percentage will be calculated automatically by using the following formula and results will be displayed under label 'Report Generation/Print Report'.

(i) The Moisture content (%)

$$M_d = \left(\frac{W_i - W_f}{W_f} \right) \times 100$$

where, M_{db} is moisture content on dry basis (%, db);
W_i is mass of sample prior to drying (g); and,
W_f is mass of sample after drying (g)

The moisture content can be converted from dry basis to wet basis using the following relationship.

$$M_w = \frac{100\, M_d}{(100 + M_d)}$$

where, M_w is moisture content on wet basis (%, wb).

Table 1. Participating centres of AICRP on PHET

Akola-PDKV	Coimbatore - TNAU	Kharagpur-IIT	Raipur-IGKVV
Almora- VPKAS	Hisar-CCS HAU	Lucknow-IISR	Ranchi-BAU
Bangalore-UAS	Jabalpur-JNKVV	Ludhiana-PAU	Srinagar-SKUAST
Bapatla-ANGRAU	Jorhat-AAU	Pusa-RAU	Tavanur – KAU
Bhubaneswar-OUAT	Junagadh-JAU	Raichur – UAS	Udaipur-MPAU

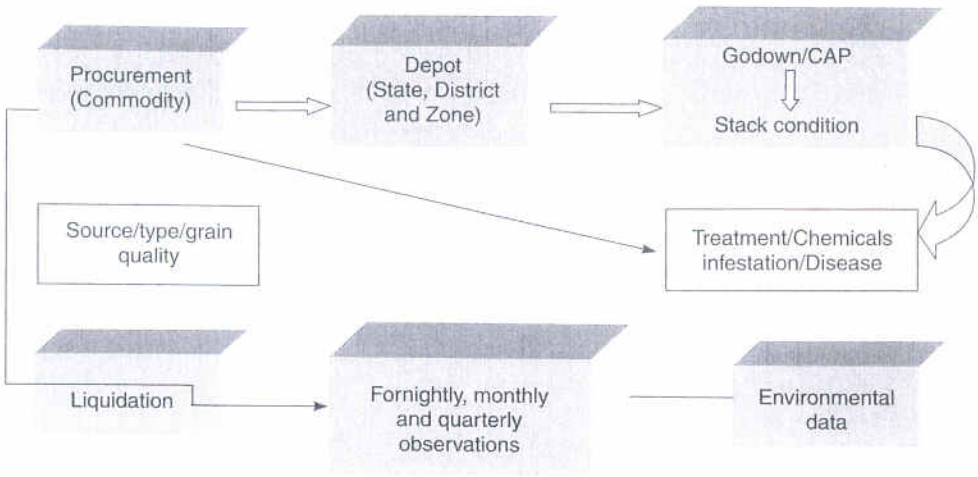

Fig. 2. Entity relationship diagram

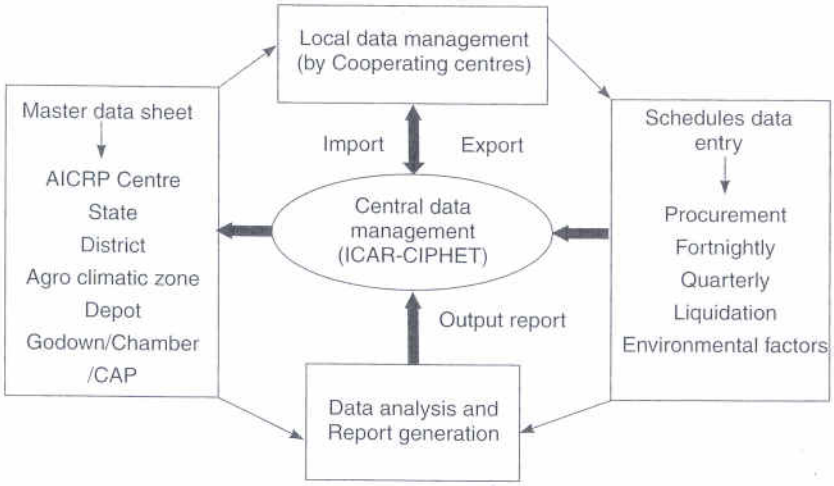

Fig. 3. Data entry software architecture

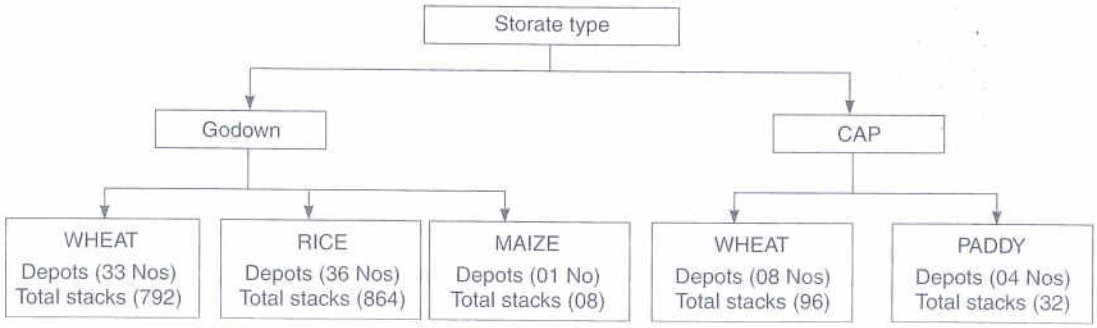

Fig. 4. Selected commodity depots

(ii) Loss/gain in weight (%) on actual weighment basis

$$\text{Gain/loss (\%)} = \left(\frac{W_2 - W_1}{W_1}\right) \times 100$$

where, W_1, initial weight of food grain (kg);
W_2, final weight of food grain (kg)

(iii) 1000-grain weight (TGW)

$$M_t = \frac{1000 \times W_p}{n}$$

where, M_t, 1000-grain weight (g);
n, number of grains;
W_p, weight of n grains (g).

(iv) Loss due to insect infestation will be estimated using standard method prescribed by Bureau of Indian Standards BIS vide IS: 4333 (Part I) and IS: 4333 (Part II).

$$L_i = \frac{\left(N_i \times M_t - 1000\, M_p\right)}{1000\, M_t} \times 100$$

where, L_i, Loss due to insect infestation (%);

N_i, number of insect damaged grains;

M_p, weight of *Ni* insect damaged grains (g);

M_t, initial 1000-grain weight (g).

All weights were converted to initial moisture content basis to eliminate the effect of moisture gain or loss.

Designing of database

The database was developed for recording data in software in well structured sheet/tables. The recorded data helps in defining the structure of files in the database. The developed software comprises of Main Switchboard (8 subsystems), Master data (7 subsystems), Schedules data entry (6 subsystem), as presented in Fig. 5.

The master data need to be entered once and the software establish links with Schedule data. The procurement/liquidation need to be entered in the scheduled sheet of database (Fig. 6). Further data integrity and security are maintained by those who are authorized to use, update and delete. Moreover, the provision of primary key favours no duplicity and acts as a unique identifier to a user.

Flow of data input and output

The following sequence of data flow is to be followed

1. Initially, details of each depot and their godowns are to be entered.
2. Date of procurement details are to be entered by each godowns
3. Periodic sample results and their corresponding commodity procurement reference are to be entered by each centre.
4. Liquidation details and their corresponding commodity procurement reference are to be entered by each centre.
5. Monthly environmental data to be entered by each Centre.
6. Whenever any updates are needed in any schedule, the required changes are to be entered.
7. All the data entered/updated need to be sent to CIPHET using the export utility provided. For migrating the individual centre data in central database, import utility provided will be used.
8. Identified standard reports can be generated through the software. Data can be exported to excel for further analysis

Advantage of the data entry software

It is a computer-based system intended to retrieve, extract and integrate data from various sources in order to analyze the extent of losses/gain in the storage study (Kamisli, 2004). The built software has following characteristics:

1. It is user-friendly software designed to store and retrieve the data in an efficient and systematic way.

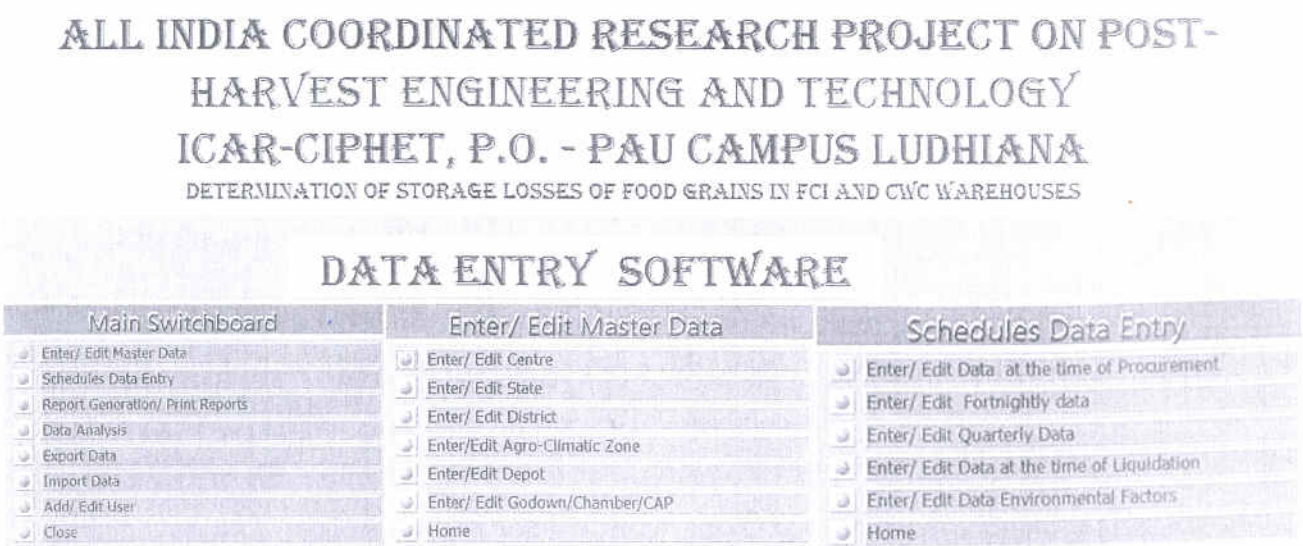

Fig. 5. Sheets of data entry software

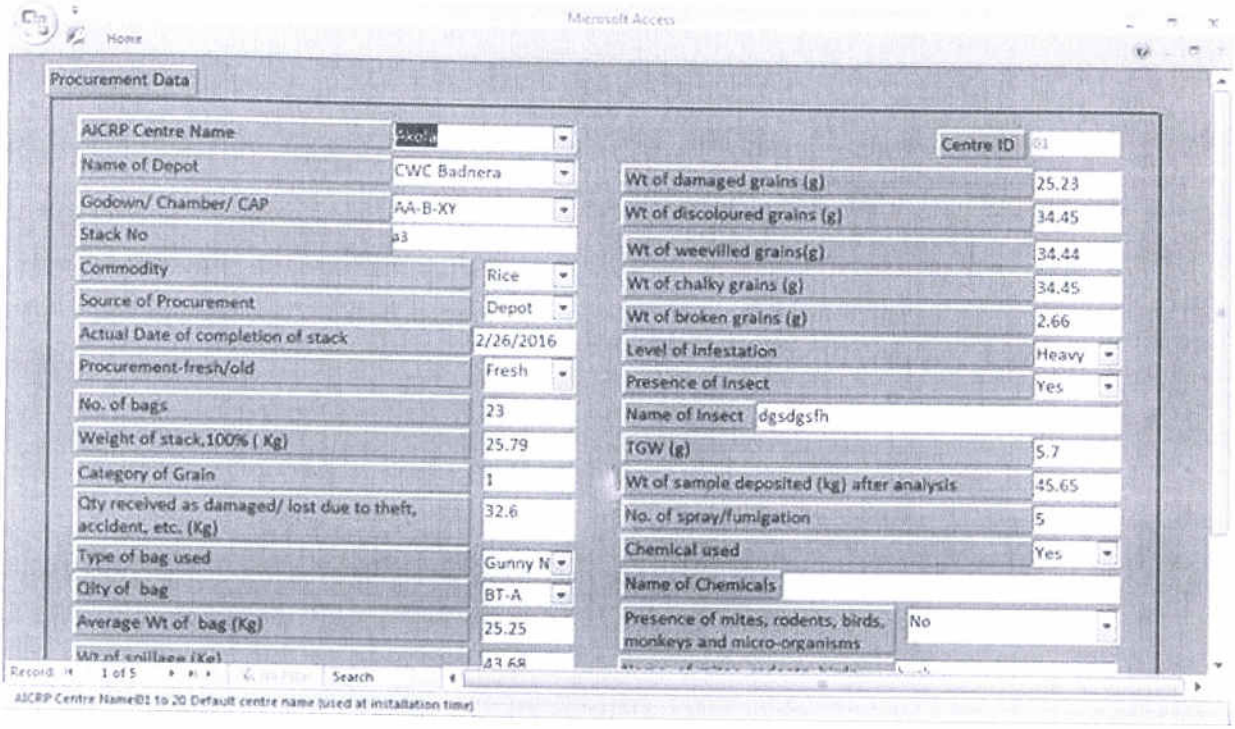

Fig. 6. Entry form and report generation

2. It supports record keeping and data processing functions.
3. All data and information can be used only by one authorized personnel, thus system's security is provided.
4. Primary keys are provided, hence no duplicity is favoured.

CONCLUSION

This paper has discussed aspects of Data Entry Software, their potential advantages, and aspects of their utilization in research and investigation of food grain storage losses in public storage system. The data redundancy and integrity problems can be solved if data is to be entered in a systematic format. Besides, easy and convenient retrieval of information in desired format helps in monitoring the depots. The percent loss/ gain figures helps in further designing the modalities and policy and to recommend norms for storage losses in efficient warehouse management.

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