

On-line Data Management System for Long Term Fertilizer Experiments

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SUMMARY

The present era has seen an exponential growth and diversification in all forms of on-line data management system, which is sometimes called, as information explosion. It has become possible due to the impact of computer technology on the modern society. Computerized data management systems have influenced nearly all types of organizations, whether small or large, public or private, national or multinational. On-line data management systems exist for almost all the fields may be Farm Management, Industry Management or Satellite Management etc. On-line Data Management System for Long Term Fertilizers Experiments (ODMSLTFE) is an attempt to develop such a web based user-friendly, integrated solution for the data management activities of AICRP on long term fertilizer experiments. The AICRP experiments are in operation for several years and they obviously require the present system.

It has a three-layered architecture. Client Side Interface Layer implemented in HTML and JavaScript, Server Side Application Layer in Java Server Pages and Java Database Connectivity. Database Layer is implemented in Microsoft Access 2000. ODMSLTFE can be implemented as a network-based system with a server at a central location (IASRI) so that information is available on-line. ODMSLTFE runs at any node of the Internet through a browser. Security features are provided in such a way that only concerned person can access the database. There is provision to insert and update the information.

ODMSLTFE provides information about centers, experiments, crops grown and attributes involved. The detailed information can be viewed through search facility options. Users can interact with concerned people through e-mail. On-line help is provided for administrator, nodal administrator and users. Further, the feature of providing information to users through frequently asked questions is also incorporated.

This system will be of much use to scientists, planners and newcomers as long term experiments continue for many years and in that period some people retire and new join in the project.

Key words : LTFE, Long Term Fertilizer Experiments, Agriculture, Information System, AICRP, ODMSLTFE.

1. INTRODUCTION

In agricultural experiments, there are reasons to believe that fertilizer treatments once applied on a crop may not fully react during the crop season. The treatments may leave residual effect on the succeeding crop. For example, very often nitrogen shows a fair response on a crop during the season it is applied. However, due to the increase in plant growth accelerated by repeated application of nitrogen, response to

phosphorus and potash generally becomes visible in the second and third year of experimentation. To formulate fertilizer recommendations for crops, it is therefore, essential that the experiment be repeated over time at the same site as the effects of climate, soil, fertilizer, agronomic practices, etc. gets stabilized only after few years and responses to fertilizer treatments also becomes more stable and reliable. Long-term field experiments, therefore, form one of the most useful tools for technical advances and are indispensable for framing empirical

rules for the conduct of practical agriculture. These experiments can be used for precise monitoring of changes in soil fertility and soil productivity.

1.1 Scenario of Long Term Experiments

Long Term Experiments are those, which are conducted on the same set of experimental units over a sequence of years with pre-planned sequence of treatments or crops or both and are mainly carried out to study the long term effects of given treatments and crops on soil fertility and economic returns. These may be with seasonal crops, annual crop sequences, perennial crops or a combination of three. Long term fertilizer experiments, long term rotational experiments etc. fall under the category of long term experiments with seasonal crops or annual crops sequence. These experiments include fertilizer experiments with cereal crops, irrigation experiments, tillage experiments, NPK status of soil, experiments on biomass production of cereals, experiments on crop rotation, effect of green manure etc.

1.2 All India Coordinated Research Project on LTFE

As the agriculture scenario of the country changed due to research, the use of biocides, high yielding fertilizer responsive dwarf varieties of crops, multiple cropping systems increased at a great pace. The use of fertilizers became a key factor for increasing agricultural production. Therefore, a need was felt for studying the impact of fertilizers not only on the crop yield and quality but also on the soil and environment under intensive cropping system. In the light of these emerging situations the Indian Council of Agricultural Research launched the All India Coordinated Research Project (AICRP) on Long Term Fertilizer Experiments at 17 centers at different locations. At the behest of the Project Coordinator (LTFE), IASRI started collaborating with AICRP. As a result, data on long term fertilizer experiments at permanent sites under AICRP and LTFE was received, processed and maintained at IASRI. This data was augmented further with that on long term experiments being conducted elsewhere in India under Crop and Horticulture Divisions of ICAR for preparing a National Database (agro ecosystem wise), so as to provide a common platform for such studies. Hence, an

AP Cess funded project entitled 'National Information System on Long Term Fertilizer Experiments' under NRM division of ICAR was formulated and is functioning from 1st June, 2003.

1.3 Data Storage of LTFE in Electronic Form

Data is entered at IASRI for all the co-operating centers. The format of the data is described below

- (i) Yield: Grain and Straw
- (ii) Plant nutrient uptake separately for grain and straw in respect of
 - ◆ Primary nutrients - N, P and K
 - ◆ Secondary nutrients - Ca, Mg and Sulphur
 - ◆ Micronutrients - Zn, Fe, Mn and Cu
- (iii) Available soil nutrients either after the harvest of each crop or completion of each crop cycle at the depth of 0-15 cm in respect of the following characters
 - ◆ E.C. pH, O.C. and Bulk Density
 - ◆ Available N, P, K, Ca, Mg, S, Zn, Fe, Mn and Cu

In addition to the above primary characters, some derived characters for total plant nutrients uptake are generated by combining the grain and straw uptakes for each crop as well as for the cropping system. The weekly weather data of important parameters viz. total rainfall and number of rainy days, maximum and minimum temperature, humidity and wind velocity etc. are being reported for the respective crop durations. Thus, about 1800 data schedules for different characters of respective crops in the sequence are being received yearly which are scrutinized and analyzed at IASRI.

Therefore, it was thought that developing on-line data management system for long term fertilizer experiments will be of much help for such experiments and scientists associated with this project. The present work is an attempt in this direction and is achieved by developing this software for on-line data management. As a result, the work relating to conversion of data to electronic form (which at present is done at IASRI) will be distributed among different centers conducting LTFE leading to efficient utilization of resources.

2. SYSTEM ARCHITECTURE AND REQUIREMENTS

ODMSLTFE has been designed with a layered structure wherein each layer corresponds to a particular functionality. The design of ODMSLTFE (Fig. 1) is made up of three layers viz. User Interface Layer (UIL), Application Layer (APL) and Database Layer (DBL).

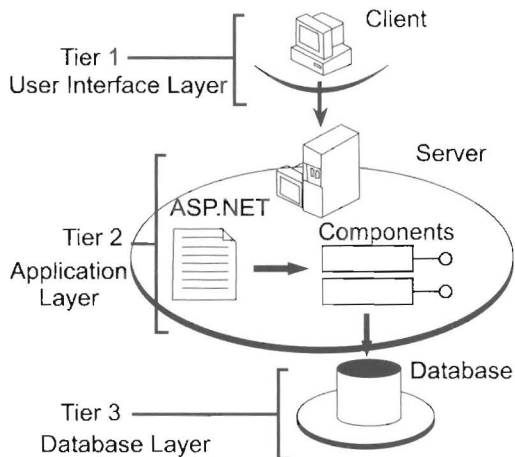


Fig. 1. Three Tier Architecture of ODMSLTFE

User Interface Layer (UIL)

The User Interface Layer of the system is implemented using HTML (Hyper Text Markup Language) and JavaScript. The UIL consists of forms for accepting information from the user and validating those forms using JavaScript.

Application Layer (APL)

Server Side Application Layer is implemented using Java Server Pages™ (JSP). This technology generates

HTML pages according to the user’s action and request. Fig. 2 shows one of the most common ways of using JSP.

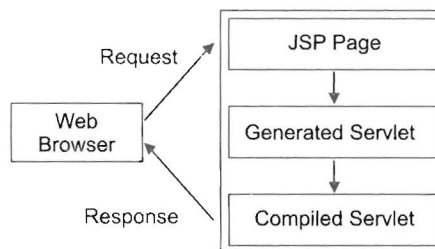


Fig. 2 . Building Web Pages with Java Server Pages

Database Layer (DBL)

Database Layer of the system is implemented using Microsoft Access 2000. It is used for designing the Tables, Relationships, Referential Integrity Rules and Queries. The relational approach has been used to design the database. The fundamentals of Normalization theory have been used to normalize different tables of the database (Loney 2004). All tables have proper interaction among themselves via primary key - foreign key relationship.

ODMSLTFE is developed as a web-based application. Only requirement at the client side is web browser in order to access the application.

3. FUNCTIONALITIES OF ODMSLTFE

ODMSLTFE is web-based, user-friendly and integrated system. Fig. 3 shows the home page of the system.

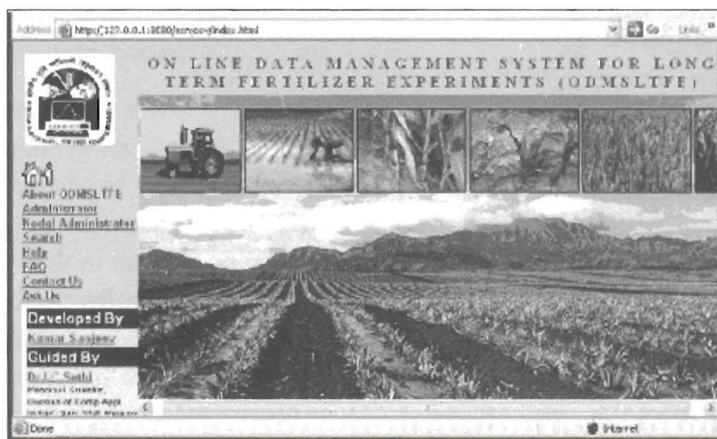


Fig. 3. Home Page of ODMSLTFE

3.1 Type of Users

There are normally three types of users for the system. These are

1. Administrators
2. Nodal Administrators
3. End Users

Administrator is the user who manages the overall system and has the right to add, modify, delete or update any part of the information captured in the database. Therefore, for security they can access the system only after entering authentic username and password.

Nodal administrators are the users who manage the system and they, therefore, have the right to add, modify or update any part of the experimental information captured in the database at particular centre.

End users are the persons who can retrieve information from the system regarding centre, experiment, bifurcated experiments, weather parameters, crop, fertilizers dose, experimental data and bifurcated

experimental data. They can quench their query by viewing the frequently asked questions or send e-mail to concerned developers and get the satisfactory answers.

3.2 Administrator Operations

Administrator can add, modify and delete information according to the need. In add, modify, delete operation, administrator can see the category option like crop, variety, crop sequence, centre, character, state, taxonomic class, treatment, super imposed treatment and frequently ask question (FAQ). This operation is shown in Fig. 4 and Fig. 5.

3.3 Nodal Administrator Operations

Nodal administrators after authentication can add, modify information as per the need of its own center. In add, modify operation he can see the category option like Experiment Information, Bifurcate Information, Weather Parameter, Crop Information, Fertilizer Dose, Experimental Data, and Experimental Data with Bifurcated Treatments. Operations are shown in Fig. 6, 7, 8 and 9.

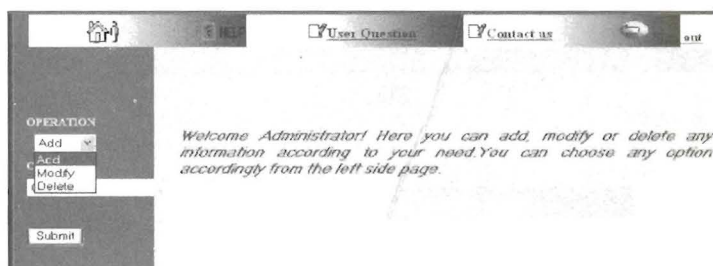


Fig. 4



Fig. 5

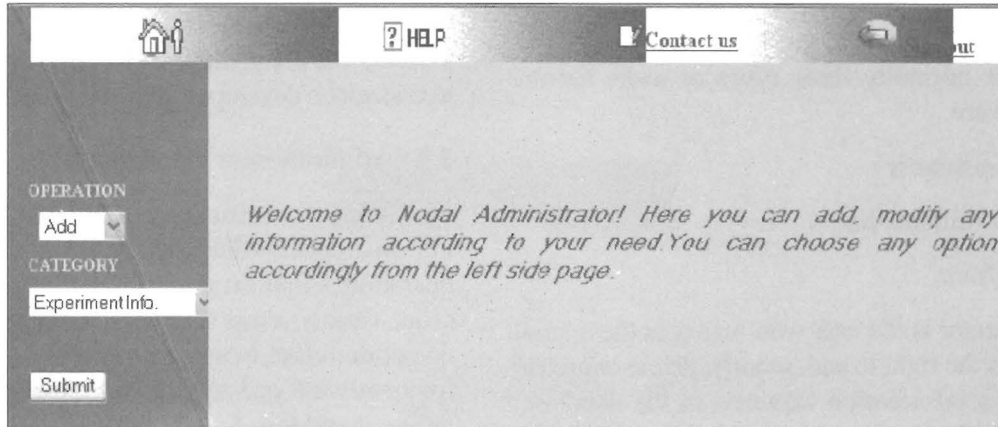


Fig. 6

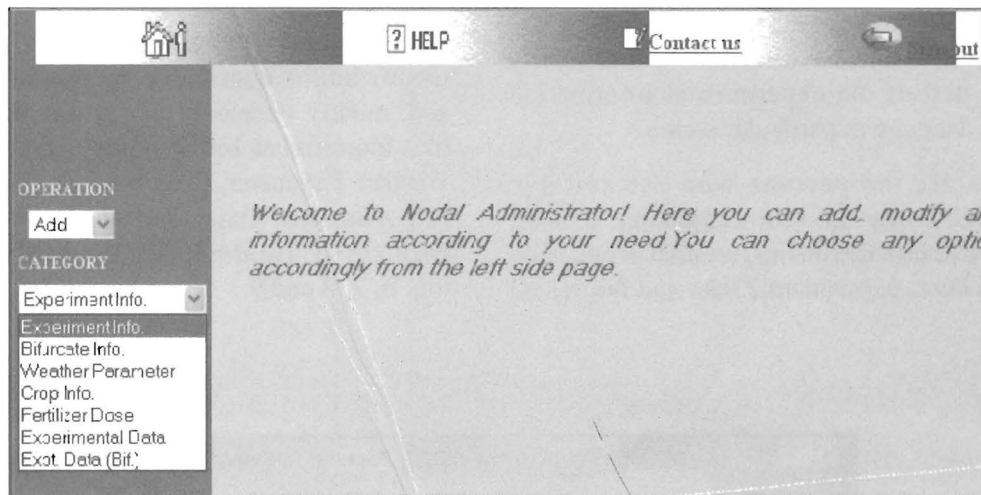


Fig. 7

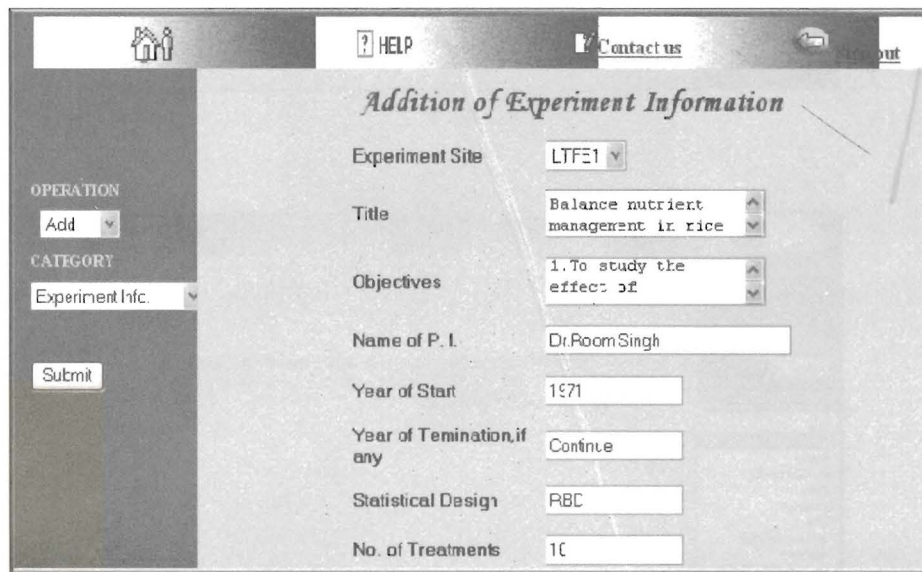


Fig. 8

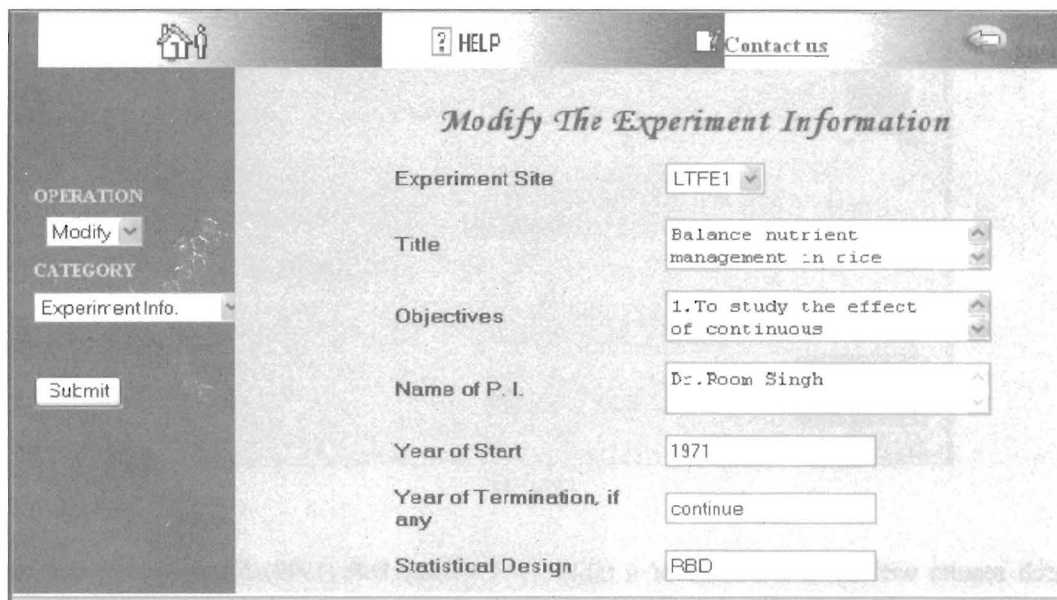


Fig. 9

4. REPORT GENERATION

User can retrieve information from this system through searching. Users can select any topic according to their needs. The search page is shown in Fig. 10. They can search the following

Centre Information

- ◆ Location of the centre
- ◆ Related information of centres

Experiment Information

- ◆ Title and objectives of experiments
- ◆ Name of statistical designs
- ◆ Number of replications and treatments
- ◆ Mid course bifurcation done in the experiment (if any)

- ◆ Number of original treatments bifurcated
- ◆ Number of superimposed treatments within the original treatment

Crop Information

- ◆ Crops category, crop and their varieties name
- ◆ Treatment input doses
- ◆ Sowing and harvesting data
- ◆ Crop damage with reason (if any)

Attribute Information

- ◆ Yield data: grain and straw
- ◆ Primary, secondary and micronutrients uptake data by plants
- ◆ Available soil nutrients and other characters
- ◆ Weekly weather parameters

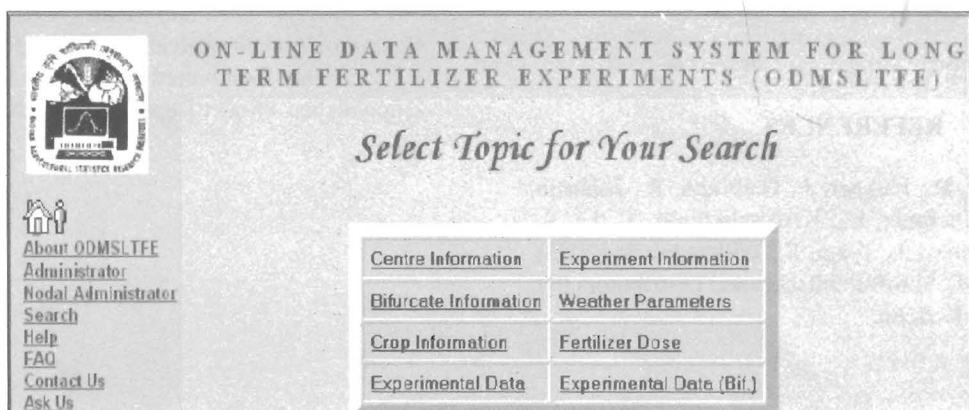


Fig. 10

ON-LINE DATA MANAGEMENT SYSTEM FOR LONG TERM FERTILIZER EXPERIMENTS (ODMSLTFE)

Search Result of Weather Parameters for (Pantnagar, 2000, Kharif)

SLNo.	Week	Total Rainy Days	Total Rainfall (mm)	Maximum Temp (deg.cel)	Minimum Temp (deg.cel)	Maximum RH (%)	Minimum RH (%)	Mean Wind Velocity (km/h)	Average Sun Shine Hours/Week
1	July 9-15	4.0	100.8	33.3	26.6	84.0	63.0	6.7	5.4
2	July 16-22	3.0	51.6	31.3	25.3	90.0	74.0	5.0	4.2

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BACK New Search

Fig. 11

The search results will be in the form of a table including various fields of information. Fig. 11 shows the result of search on weather parameter for experimental centre.

5. MAJOR CONCLUSIONS AND RECOMMENDATIONS OF STUDY

On-line Data Management System for Long Term Fertilizer Experiments (ODMSLTFE) will be of much help to the personnel associated with LTFE. This system will facilitate in compiling the data at a central place, at the same time will aid the entry of data from different locations on-line. New and experienced workers can benefit a lot by using ODMSLTFE. This system will act like ready reference and will help the workers to plan, type of experiments, which can continue providing higher crop production over several decades. Further, this can help in monitoring changes in soils' physical, chemical and microbiological characteristics in relation to its productivity in the long run, as well as to plan experiments after viewing the data of fertilizer application as stored in the system.

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