Bulletin of Environment, Pharmacology and Life Sciences
Bull. Env. Pharmacol. Life Sci., Vol 6 Special issue [3] 2017: 72-80

Online ISSN 2277-1808
Journal's URL:http://www.bepls.com
CODEN: BEPLAD
Global Impact Factor 0.533
Universal Impact Factor 0.9804
NAAS Rating 4.95

FULL LENGTH ARTICLE **OPEN ACCESS**

Development and Management of Database for Mobile based Agri-Informatic Systems

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ABSTRACT
Telecommunications, especially the mobile phones have huge potential in providing solutions to the existing asymmetry in information in different sectors including agriculture. The public agriculture extension system which is responsible for disseminating agricultural information to farmers has become less effective, more time consuming and unsuccessful in meeting the requirements of those involved in agricultural production and there is a gap between the extension agents and the farmers. There are several organisations extensively using modern information and communication technologies to facilitate better communication and multi-directional information flow between the researchers, extension personnel and the farmers in a timely and cost effective manner. Among the ICTs deployed for agro-advisory services, mobile phones have been very effective in terms of affordability and effectiveness of the service to the farmers directly. In this backdrop, the paper describes the technical aspect of the database development and management for a mobile based SMS service to the farmers. The objective of the study is to understand the functioning and process of query and solution retrieval from a vast amount of information available. The tools used for the study were MS Access and MySQL 4.1 version. The study area selected for developing the database is Andhra Pradesh and the major crops grown in the state.
Keywords: Mobile phone, Agriculture, ICTs, MySQL, Information systems

Received 13.07.2017 Revised 02.08.2017 Accepted 21.08. 2017

INTRODUCTION

In India, more than half of the population is directly or indirectly dependant on agriculture and allied sectors for their income and livelihood. Agriculture serves to be the backbone of the country amidst the dwindling natural resources such as land and water that have reached their threshold limits, prices of the commodities fluctuating everyday leaving the farmers specially the small and marginal with negligible or no profits. Among all the limitations getting information has become a challenging and cumbersome. In the current scenario, availability of soft resources like information, knowledge and skill is more important than the physical resources like inputs and capital requirements. For millennia, people have used knowledge from family and friends to grow crops or raise livestock. Globally, new digital systems now exist for sharing information on agricultural innovations and markets, but most of these systems are inaccessible to poor farmers in developing countries. Today, technology can and should be a key agent for changing people's lives by improving access to information and sharing of knowledge. Rural livelihoods would be greatly enhanced by improvements in areas such as access to agricultural markets, improved agricultural practices, information on weather, including extreme events. India has achieved a major breakthrough in agricultural production as a result of technology evolved by Indian scientists and its wide adoption by the farmers. In Indian Agriculture, the factors like high soil productivity, supply of balanced crop nutrients, efficient water management, improved crops, better plant protection, post-production management for value-addition and marketing, are responsible for higher yield as compared to most of the other countries. There is enormous information available but the problem lies in disseminating the right information to the right person at the right time. The requirement of field level extension personnel is estimated to be about 1.3 -1.5 million against the present availability of about 0.1 million personnel (PC, GOI, 2007). The ratio of extension worker to farmer is 1:1500 against an estimated of 1:500 (Gowda, 2011). This wretched scenario has led to a poor dissemination of information and

services to the farming community. To cope up with this situation the ICTs can play a supplementary role in quicker and effective information dissemination thereby enhancing technology transfer and adoption. According to the survey conducted by the NSSO in 2005 it has been indicated that 60% of the farmers do not access any information source of information for advanced technologies there by resulting in a vast adoption gap. (NSSO, 2005). During Green revolution the impact of mass media tools such as the radio and television has been enormous and is a success factor for information dissemination, technology diffusion and adoption thereby promoting the country from a state of food deficit to food surplus nation. Now integration of the ICTs with the traditional system of extension will be a boon to achieve ever green revolution. Strategies have been formulated by the Indian government and policy makers to enhance the use of ICTs in agriculture. The penetration of mobile phones in India from 2001 to 2008 as per the TRAI report shows that the CAGR rate is 35% (TRAI, 2012). There are many government and private initiatives in information delivery using mobile phones; a few to name are the Kisan Call Centre, IFFCO Kisan Sanchar Limited (IKSL), Reuters Market Lite (RML), Fisher Friend etc.

Mobile applications in India: Review

Farmer Call Centre (Kissan Call Centre)

The Department of Agriculture & Cooperation (DoA&C), Ministry of Agriculture, Govt. of India launched Farmer Call Centres across the country on January 21, 2004, to deliver extension services to the farming community. The purpose of these call centres is to respond to issues raised by farmers, instantly, in the local language. There are call centres for every state which are expected to handle traffic from any part of the country. Queries related to agriculture and allied sectors are being addressed through these call centres.

Fisher Friend

QUALCOMM, M. S. Swaminathan Research Foundation (MSSRF), Tata Teleservices and Asute System Technology jointly implemented mobile based advisory services (instant access to helpful information such as weather conditions, where they can and cannot fish and seeking information on market prices) to fishing communities of costal Tamil Nadu since, 2007.

IFFCO Kisan Sanchar Limited (IKSL)

Bharti Airtel Limited, India's leading integrated telecommunications services provider, and Indian Farmers Fertiliser Cooperative limited (IFFCO) launched a joint venture company IFFCO Kisan Sanchar Limited (IKSL) in 2008, that is set to provide a major boost to Indian agriculture and the rural economy at large. Through voice messages in local languages. 95 000 voice messages have been delivered and 81 000 Q&A repository with 5 000 feedback messages from the farmers have been received. 1.3 million active farmers are benefiting from IKSL's Value Added Services and IKSL enrollment has crossed four million with forty thousand cooperative societies operating as IKSL Retailers (www.iksl.in).

Reuters Market Light (RML)

Micro-information Services designed specifically for the farming community was launched by RML in 2007. It currently covers over 440 crops and varieties with more than 1 400 markets and 2 800 weather locations of 15 000 villages in 13 States of India. Timely and personalized information and individual farmers have reaped significant return on their investment achieving up to INR 200 000 ($ 4 000) of additional profits, and savings of nearly INR 400 000 ($8000) by using RML (www.reutersmarketlight.com).

Nokia Life Tools

Nokia Life Tools is a range of services which include agriculture, education and entertainment services designed specially, for the consumers in small towns and rural areas of the emerging markets. The service provides timely and relevant information customized to the user's location and personal preferences directly on their mobile phones.

Fasal

Fasal is a free SMS based product connecting rural farmers to buyers and provides them up-to-date price information. Fasal, which started in 2008, establishes buyer-seller connection using SMS. The service is currently available in Gujarat, Andhra Pradesh and Karnataka. Farmers can register by calling a toll free number to the local language call centres at 1800 102 8767 and a Fasal agent creates a profile of that farmer with location, crops grown, farm size, cropping dates, personal assets, annual income, etc. The farmers then receive personalised SMS based on his crops and location from time to time.

Warana Unwired

This project by Warana Cooperative, a sugarcane farmers' group and Microsoft Research India was launched in January, 2006, and was functional till November, 2007. Agricultural information was passed on to the farmers of the region through kiosks. An SMS alert is sent through SMS toolkit which provides a PC-based programmable interface to SMS messaging via a connection to an SMS sending/ receiving port.

Methodology

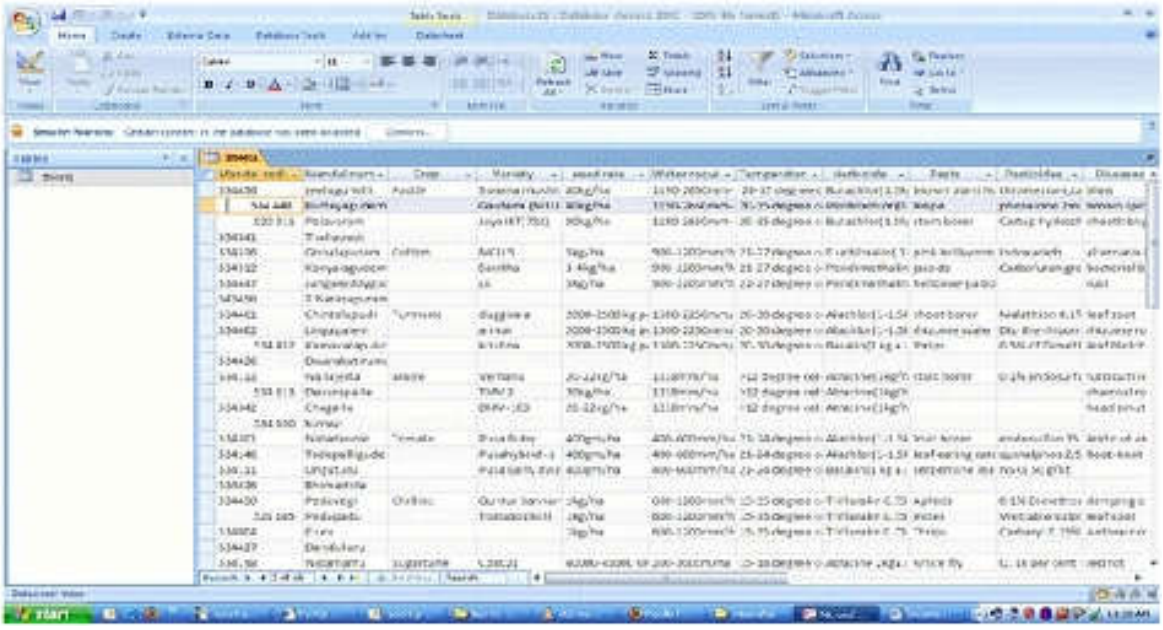
MBAIS is an SMS driven solution where in the farmer sends a query to the organization through an SMS and receives the reply back as an SMS. The back end process that takes place here is the setup of a server where the database about the required information is prepared and stored, from which the relevant and specific data would be retrieved and sent back to the farmer. To create the database MS Access and My SQL 4.1 version were used which generate databases and help in easy retrieval of data from the vast amount of information available. Also the problems of data redundancy, non-reliability can be checked upon and provide accurate and timely solutions to the farmers. The database created once is updated regularly in terms of the commodity price and its market location and demand. My SQL gives the flexibility of altering the data as and when required. More investment in infrastructure and skilled human resources is needed for such systems. Investment in communication infrastructure has to focus on financially viable and socially acceptable approaches that are accessible to the rural poor. ICT should be integrated into agricultural sector policies and lead to supportive programmes. There is ample potential for effective use of ICT in agriculture and initiatives are promising.

Database development

Database management systems have become ubiquitous as a fundamental tool for managing information. Today, the success of an organization depends on its ability to acquire accurate and timely data about its operations, to manage this data. A database is a collection of data, typically describing the activities of one or more related organizations. My SQL is a database management system. A database is a structured collection of data. It may be anything from a simple shopping list to a picture gallery or the vast amounts of information in a corporate network. To add, access, and process data stored in a computer database, you need a database management system such as My SQL Server. Since computers are very good at handling large amounts of data, database management systems play a central role in computing, as standalone utilities or as parts of other applications. My SQL Server was originally developed to handle large databases much faster than existing solutions and has been successfully used in highly demanding production environments for several years. Although under constant development, My SQL Server today offers a rich and useful set of functions. Its connectivity, speed, and security make My SQL Server highly suited for accessing databases on the Internet. The various components of My SQL include:

- Entering queries
- Creating and Using Database
- Creating and Selecting a Database
- Creating a table
- Loading Data into a table
- Retrieving Information from a table

Using these options we can create databases and tables in a ordered manner and retrieve the data from tables. The various function statements like INSERT, DESCRIBE, USE, ALTER, DROP, UPDATE etc can be used to bring about changes in the database as and when required.



MS Access is an application in MS Office used to create databases, tables and queries. A blank database should be created initially, and then load data into the cells. This data can be organized into rows and sorted according to ascending or descending order, assign a primary key which indicates a unique identity for that attribute. In my study I have selected **Mandal code** as the unique attribute as it is not a null value and non-repetitive. The other attributes like Mandal name, crop name, variety, seed rate, water requirements are not unique as they are repetitive and sometimes have a null value.

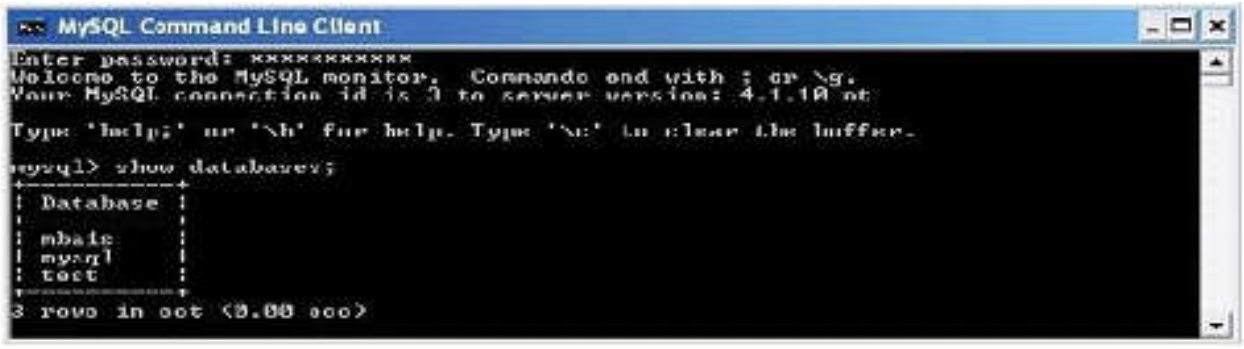


Fig 2: MBAIS database created

CREATION OF DATABASES:

The databases have been created using My SQL where in I have created a database named MBAIS using the function; (Fig 2.)

mysql> show databases; Now we have to create a new database using the statement *mysql>- create database mbais;* and the database **mbais** is created. This database has got empty rows and no data created yet.

CREATE TABLES:

In order to generate data we need to create TABLES, there are seven tables created as creating a single large database as in Access would hamper the order and representation of data would be in a jumbled format. The seven tables are: (Fig 3.)

1. mandal
2. crop_details
3. crop_variety
4. crop_seedrate
5. herbicides
6. ipm
7. idm

Fig 3: Tables in the Database MBAIS created

LOAD DATA INTO TABLES:

Each table defines the particular attributes. In table mandal, the mandal name and mandal code are defined (Fig 4.) as shown below:

mysql> SELECT * FROM MANDAL;

MN	MC
Jeelugumalli	534456
Buttayagudem	534448
POLAVARAM	520011
Thallapudi	534341
Gopalapuram	534341
Koyyalagudem	534312
Jangareddygudem	534447
T.Narasapuram	543456
Chintalapudi	534461
Lingapalem	534462
Kamavarapukota	534452
Dwarakatirumala	534426
Nallajerla	534112
Devarapalle	534313
Chagallu	534342
Kovvur	534350
Nidadavole	534301
Tadepalligudem	534146
Unguturu	534111
Bhimadole	534426
Pedavegi	534450
Pedapadu	521105
Eluru	534004
Denduluru	534427
Nidamarru	534198
Ganapavaram	534197
Pentapadu	534166
Tanuku	534211
Undrajavaram	534216
Peravali	534330
Iragavaram	534320
Attili	534230
Undi	534186
Akiveedu	534235
Kalla	534237
Bhimavaram	534204
Palakoderu	534202
Veeravasaram	534207
Penumantra	534124
Penugonda	534123
Achanta	534269
Poduru	534122
Palakol	534250
Yelamanchili	534268
Narsapuram	534275
Mogaltur	534239

The table consists of 46 Mandal codes (MC) and Mandal name (MN) and the statement used is
*SELECT * FROM Mandal;*
If you want to select a particular Mandal code or a particular Mandal name from the table Mandal, then the statement used is *SELECT * FROM Mandal WHERE MC >= 543123;* so all the Mandal codes greater than the specified code will be displayed.
The second table crop details consists of crop name CN, Water requirement WR, Temperature TEMP, Commodity Price CP, Bank, Market location MLOC , the following as displayed below (Fig 5.)

MySQL Command Line Client

mysql> SELECT * FROM crop_details;

CN	WR	TEMP	CP	BANK	MLOC
Paddy(P)	1190-2650mm/ha	20-35deg.cel	Rs.775/bag	APCOB	Palakol
Cotton(C)	900-1200mm/ha	21-27deg.cel	Rs.750/bale	AndhraBank	Warangal
Turmeric(T)	1500-2250mm/ha	20-30deg.cel	Rs.1800-2000/quintal	AndhraBank	Tadepalligudem
Maize(M)	1238mm/ha	>12deg.cel	Rs.570/quintal	AndhraBank	Tadepalligudem
Chillies(c)	600-1200mm/ha	15-35deg.cel	Rs.4000/quintal	AndhraBank	Guntur
Tomato(t)	400-600mm/ha	21-24deg.cel	Rs.600/quintal	APCOB	Tadepalligudem
Sugarcane(S)	200-300cm/ha	15-18deg.cel	Rs.1140/tonne	ICICI	Kovvur
Sesame(s)	1200-2500mm/ha	27-33deg.cel	Rs.2100/quintal	AndhraBank	Palakoderu
Tobacco(p)	400-600mm/ha	26-32deg.cel	Rs.3900-4000/quintal	AndhraBank	Rajamundry
Greengram(G)	60-75cm/yr	25-35deg.cel	Rs.24-60/kg	ICICI	Rajamundry
Brinjal(B)	100-110cm/ha	21-29deg.cel	Rs.1400/quintal	AndhraBank	Eluru

11 rows in set (0.00 sec)

Fig 5: Database Table of Crop Details

A query can be asked like
*SELECT * FROM crop_details WHERE CN = Paddy AND WR <=1200mm/ha;* and the result displayed is "Paddy”,"1190mm/ha".
The third table is crop variety where in the crop and its three varieties are given along with abbreviations, for example paddy variety Swarnamukhi is abbreviated as PV1 and other varieties as

PV2 and PV3. The table is displayed as follows (Fig 6.);

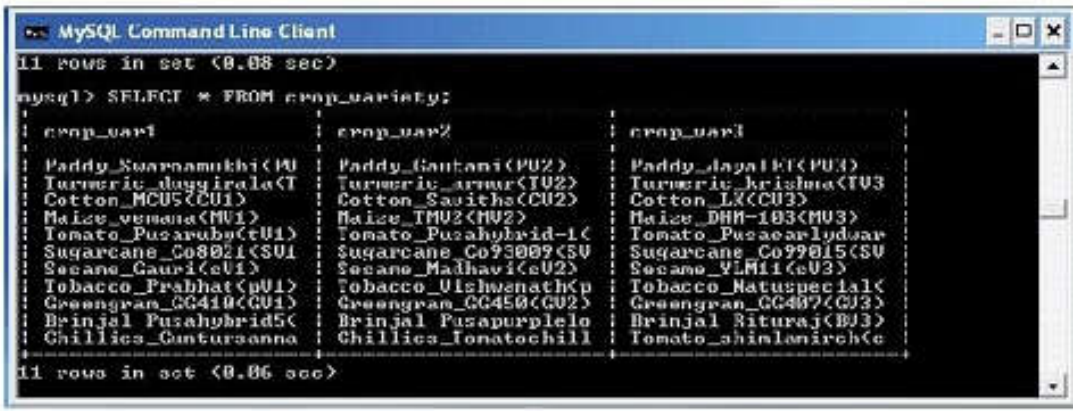


Fig 6: Crop variety Table

The fourth table crop_seedrate describes about the crop variety and its seed rate; the abbreviations are PVI SR1 which corresponds to paddy variety 1 and seed rate 1, similarly for the other crops, as displayed below Fig 7.

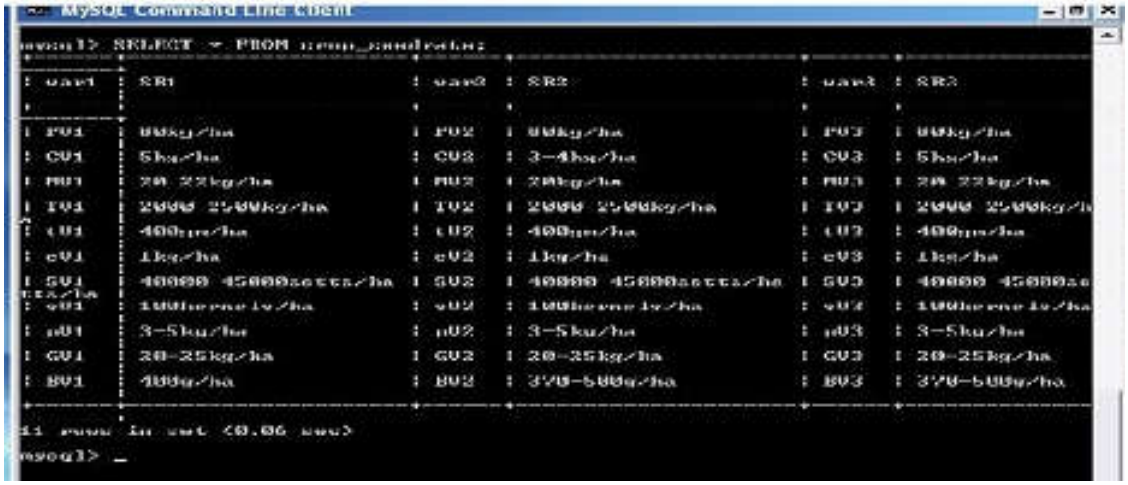


Fig 7: Crop seed rate Table

The table five named as herbicides gives the details of herbicides used for the particular crop and particular variety, as shown in Fig 8.

Fig 8: Herbicide Table

Table six consists of ipm which describes the crop variety, pest and pesticides which are abbreviated as 'PV1P1PSCD1' means paddy variety 1 pest 1 pesticide 1 and the corresponding result is displayed.(Fig 9.)

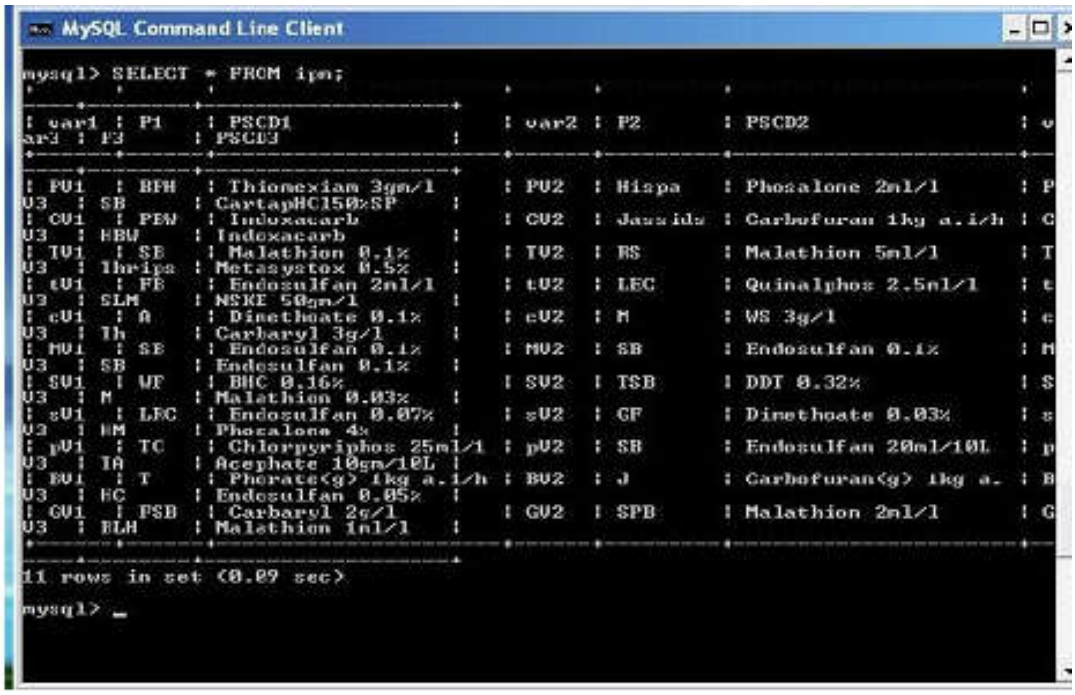
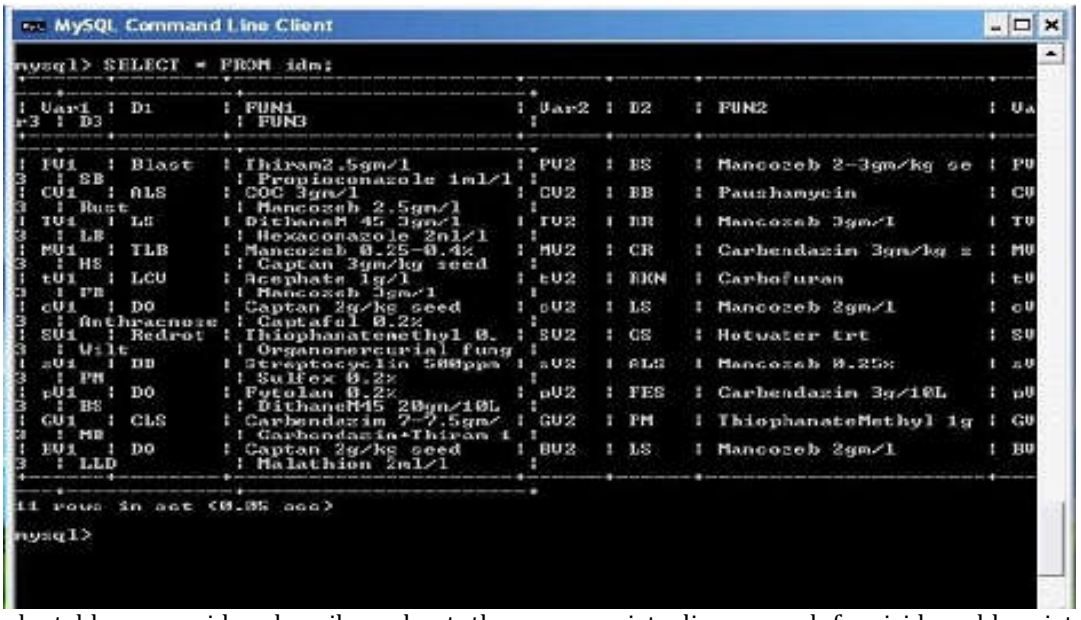


Fig 9: IPM Table



Similarly table seven idm describes about the crop variety,disease and fungicides abbreviated as 'PVID1FUN1' as shown in Fig 10. The statement used is *SELECT * FROM idm;*

Fig 10: IDM Table

Thus the database is created using multiple tables. From this database the queries asked by the farmer are answered. As it is SMS driven the text capacity would be very limited about 160 letters, keeping this in view the query length should be decided. If suppose the farmer has a query like

What is the fungicide to be used for tomato leaf curl virus disease?

This big question cannot be understood by the database, therefore there will be a coding format where in the database takes only the abbreviation used as 'tV1D1FUN1' and the reply would be "tV1LCVAcephate 1g/l". The same is followed for all the crops.

RESULTS AND DISCUSSION

DATA RETRIEVAL:

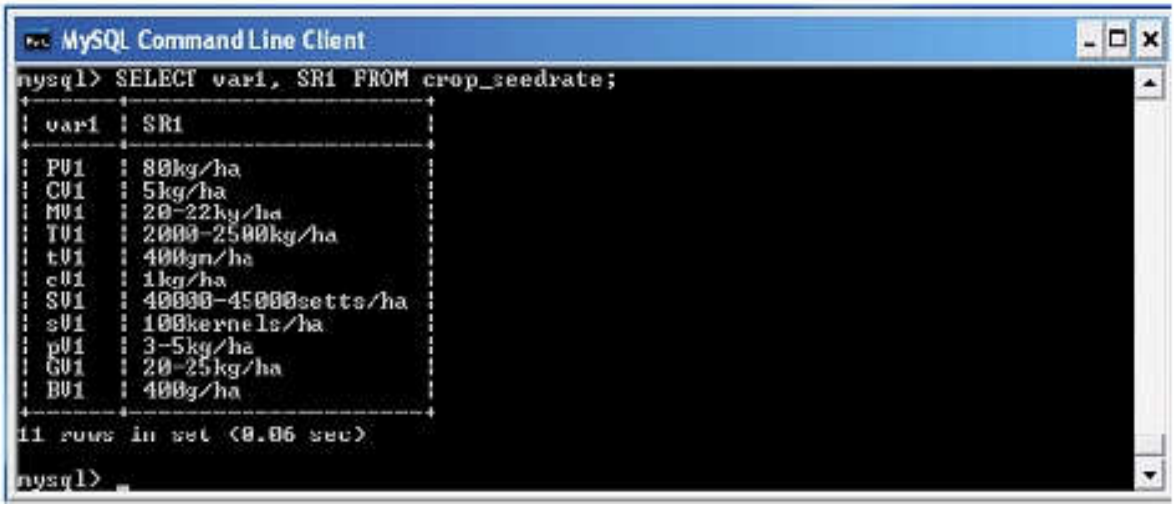


Fig 11: Result Table for Variety and Seed rate

The results generated will be sent to the server from where the mobile receives the SMS. Meanwhile there is some technical process involved where in a programming code for the software to convert the simple query asked by the farmer into code understandable by the server and again the result will be displayed in a format where the farmer can understand. The abbreviations used are only for the convenience of the system to understand but not the client or the farmer. If we want to select only var1 and seed rate1 of all the crops then it would be displayed as follows: (Fig 11.)
To find the market location and commodity price of the crop we can view as given below: (Fig 12.)

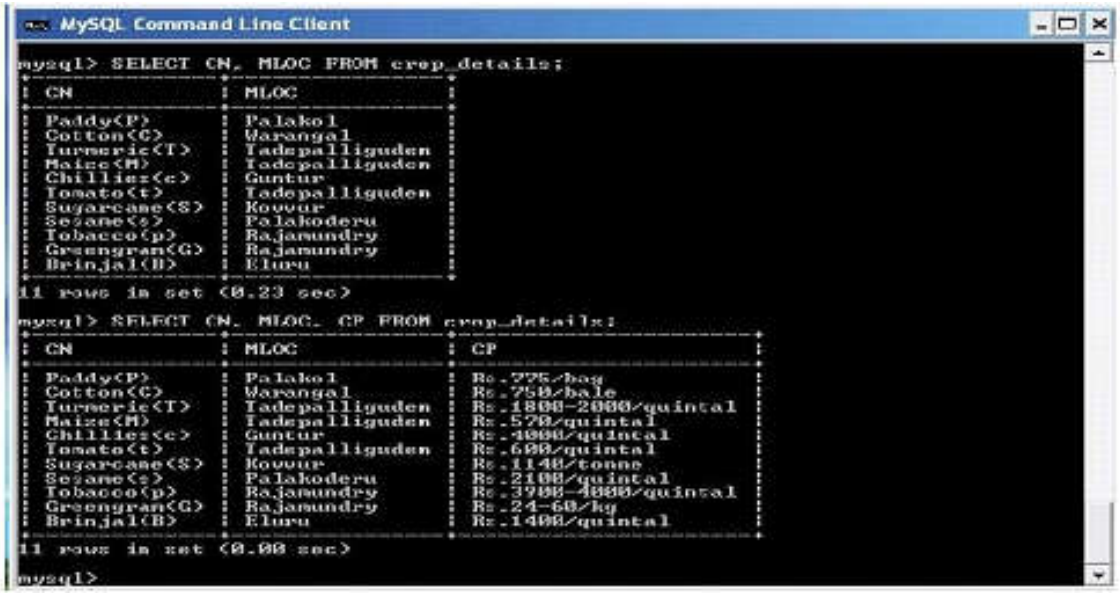


Fig 12: These results are pooled and sent to the mobile server from where the SMS is displayed on the screen. This is a novel method of providing timely solution to the farmer in an easy manner. To find the Water requirement and seedrate of turmeric then the statement used is (Fig 13.) *mysql> SELECT WR, SR FROM Turmeric;*

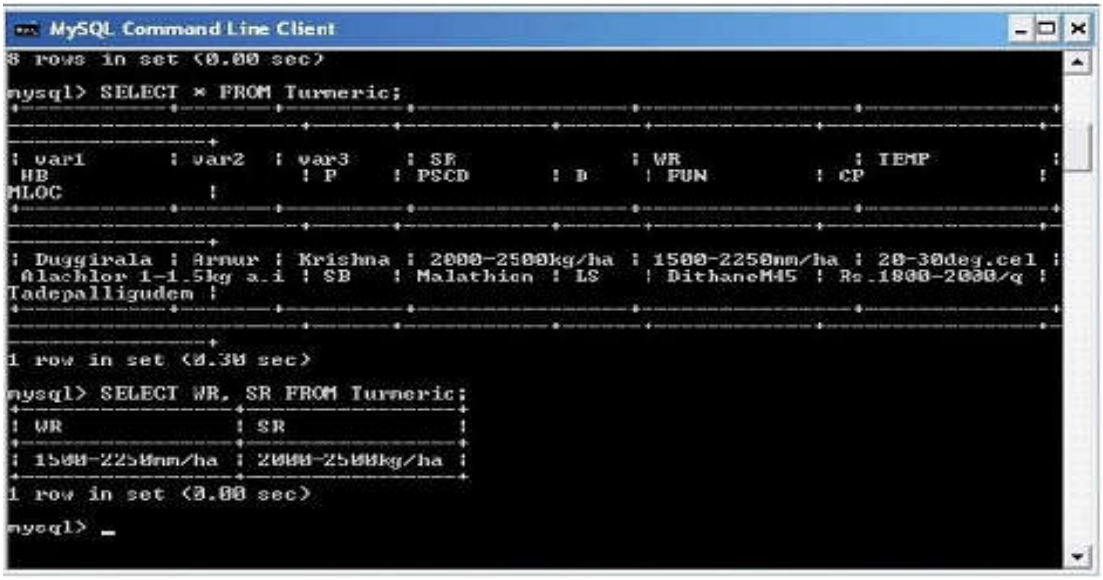


Fig 13:

CONCLUSION

The divide between those who can and cannot access ICT will widen unless efforts are made to ensure that digital technology and information is accessible as well as affordable at a local level. As computer technology becomes more sophisticated and often more expensive, developers should ensure compatibility with older hardware still in use. Information on the Internet is often not available in local languages, which seriously constrains rural people's access to otherwise relevant information. Approaches need to be developed to overcome these constraints, and the value of local knowledge emphasized in systems focused on farmers and rural communities. The database developed can be used as a foundation for future work to be carried out as this task is more time consuming and requires authentic and real time data. Once the database is developed we can make alterations to it as and when required and necessary changes can be done. This technique cannot be done as in the case of other channels of information dissemination as there is no scope of updating or two-way communication possible. The queries of the farmers cannot be answered in other modes hence this can be considered as an effective way of providing information to the farmers.

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CITATION OF THIS ARTICLE

Jyothi S.S.P, Hrishikesh Venkataraman and Supriya Pallay. Development and Management of Database for Mobile based Agri-Informatic Systems. Bull. Env. Pharmacol. Life Sci., Vol 6 Special issue [3] 2017: 72-80