Abstract

To improve their competitiveness in the global market, potato growers in Mauritius need access to timely, relevant information for decision-making. Given the increased access to the Internet in the island, a study was carried out to determine whether a computer-based information system could provide potato growers with the needed information. Potential users of the information system generally communicate in non-written languages and have low computer literacy. Following an information needs analysis of potato growers in Mauritius, a prototype agricultural information system, the Potato Extension & Training Information System (PETIS), was developed with a user-friendly multimedia interface that an illiterate grower could use. The innovation consisted of using graphical icons representing agricultural practices coupled with audible explanations in local languages to facilitate navigation through the information system. Technical information on potato production was also provided through audio files. An assessment of the prototype information system by the target users showed a high level of acceptability and potential for future information systems to adopt this design. The PETIS acts as a showcase for the feasibility of developing information systems to satisfy users with low literacy levels in non-English, non-written language environments, a common characteristic of communities in developing countries. This paper describes the development of the PETIS and presents the information system. Lessons learned from this study, relevant to the application of Information Technology for agricultural information dissemination, are also presented.
INTRODUCTION

In the wake of world trade liberalization, the Mauritian agricultural sector needs rapid and timely access to information for decision-making in order to remain competitive. The need for such an information system is already being felt in the potato industry in Mauritius especially as local production has not been able to satisfy the country’s demand, and potato prices and importation have recently been liberalized. Therefore, local potato growers need to be provided with timely, accurate, complete, understandable and relevant information for good decision making, if they are expected to play a significant role in potato production in the future.

The recent upsurge in computer technology provides for flexible and speedy information handling, large storage capacity, multimedia facilities and user friendly interfaces at reasonable prices (Bheenick, 1998). This technology, especially the World Wide Web, offers the possibility of devising a computer-based information system for potato growers to provide them with the required information. However, the Internet and the World Wide Web have remained mostly unused by the Mauritian agricultural community, despite agricultural information becoming available in electronic form. The poor adoption rate of the web by the agricultural community is attributed to low computer literacy, low levels of education, illiteracy especially among the aging rural population and a lack of relevant information in electronic form (Bheenick, 1998). In addition, most communication among the agricultural community occurs using two spoken (non-written) languages, Creole and Bhojpuri.

In order to popularize the Internet and its applications, the government of Mauritius has been providing fiscal incentives and loan facilities for individual computer purchases, introducing information technology into schools and community centers, and encouraging the creation of computer clubs at the community level. By the end of the year 2000, 176 community centers in Mauritius had been fitted with two multimedia computers connected to the Internet, and a printer (National Computer Board, 2000). Some of the problems facing the use of these facilities have been that users must learn to use the new technology, which is usually foreign to them and which often exposes them to information in a language or format which they are not used to. However, recent developments in multimedia technology on the web and improvements in the user-friendliness of the operating systems offer new possibilities for computer user interface development, making it easier than ever to use a computer to access information locally and worldwide. Therefore, a study was set up at the University of Mauritius, to test whether agricultural information on the web can be made accessible to the rural community, in a useful form and requiring minimal effort.

PURPOSE

This paper describes the approach in developing a prototype computer-based agricultural information system for potato growers in Mauritius, which takes into consideration its use by people with low levels of literacy, low computer skills, who use non-written languages, and who have low bandwidth access to the Internet.

The paper also presents the features of the information system that facilitate its use by the target audience, and the findings of a preliminary assessment of the prototype. Lessons
learned in this study, which may also apply to providing information to non-English speaking or low literacy level communities in other developing countries, are also presented.

METHODS AND DATA SOURCES

The population of potato growers in Mauritius consists of 19 large-scale growers (> 40 ha) and 400 small-scale growers, the latter generally members of cooperative associations grouped under a cooperative federation. Information on local potato production is also largely available from research and extension institutions, although dispersed and in various formats. This pilot study, carried out over six months in 1999-2000, consisted of determining the information needs of potato growers in the main production areas of Mauritius, designing a computer-based information system that could satisfy their information needs and finally getting the potato growers to assess the information system (Lukeeram, 2000).

The population surveyed consisted of 7 large-scale and 40 small-scale growers, based on stratified random sampling. The large-scale growers were randomly selected while the small-scale growers selected using cluster sampling and the list of members of the Cooperative Federation as a sampling frame. The socioeconomic profile, information needs and preferred form of obtaining the information, and accessibility to computers of these potato growers was determined through an interviewer-administered questionnaire. As part of this survey, growers also evaluated graphical icons and symbols as representations of their agricultural practices, which could be used in a graphical user interface.

Information required by the potato growers were gathered from available research and extension publications, and through requests addressed to crop extension officers. Early in this process, the crop extension officers expressed an interest in the information system being developed as potential contributors and users, as they would interact with the growers. Therefore, the crop extension officers were asked to evaluate the information system after its design and development.

In the second phase of the study, a user-friendly computerized information system using text, visuals, and audio was developed to fulfill the growers’ information needs. The innovation in this approach was to build upon the user-friendly web interface using graphical icons, previously selected by the growers, to facilitate navigation within the web site by a person with low literacy level. In addition to text, audio files provided the information in two local spoken languages.

In the third phase, growers evaluated the grouping of information, the structure of the information system and the use of graphical icons, pictures and audio files in the computer-based information system. The evaluation followed either a group or an individual presentation of the system to the participants in the preliminary survey. Illiterate growers were assisted to complete the evaluation sheet appropriately. A group presentation was also made to almost all (n=12) crop extension officers and the evaluation carried out.

Given the interest of the extension officers in the information system, in addition to the potato growers, the system was called the Potato Extension & Training Information System (PETIS).
RESULTS

Profile of growers and their attitude towards a compute-based information system
A third of potato growers were above 50 years of age and 60% between 30 to 50 years of age. Although all large-scale growers were literate, 13% of small-scale growers had not completed primary school and 7% had never attended school. Communication in spoken languages, namely Creole (100%) and Bhojuri (74%), were preferred over French (62%) and English (40%). All large-scale growers had direct access to computers and were computer literate. Only a quarter of small-scale growers had direct access to computers either at home or through their agricultural cooperative but an additional 55% believed they could access information on a computer-based system indirectly through their children, relatives and friends, using either personal equipment or those found in schools and community centers.

Over 70% of large-scale growers and 55% of small-scale growers were satisfied with the extension service provided. The main complaints provided by the rest of the respondents were the lack of practical and financial advice, untimely and inaccurate information and the use of inappropriate means of communication, which lacked graphical illustrations or were too technical. Pictures and graphics were almost unanimously acceptable as aids to communication in extension, ahead of cartoon-style drawings and television and radio. Growers considered the 29 graphical icons used to represent agricultural contexts and practices in potato production as satisfactory or excellent.

A large proportion of large-scale (86%) and small-scale (70%) growers were willing to use a computer-based information system to obtain their information, as long as it was easily accessible, user-friendly and it enabled them to get timely, understandable and relevant information. Around fifteen percent of growers were undecided, while 15% of small-scale growers were not prepared to use such a system.

The Potato Extension & Training Information System (PETIS)
The prototype information system developed is accessible from the website of the Faculty of Agriculture, University of Mauritius (http://www.uom.ac.mu) or directly at the following URL: http://202.60.1.2/cdpetis/default.htm. The user interface of the information system is based on the web interface, whereby the user browses through the information by clicking on the mouse, selecting from a series of graphical icons to reach the desired topic. The interface is further enhanced for use by illiterate people through the use of audio files, which tell the user what information they will obtain when they click on a particular icon. It is expected that the user soon associate the graphical icons with the cultural practice/context depicted.

The design of the screen layout starts off simple, with a presentation of nine sections (modules) each representing a category of information needs in potato cultivation, ranging from prerequisites to land preparation and disease control. Each module is displayed as a labeled graphical icon with a hyperlink. In addition, audio support indicates what the icon represents both in Creole and in Bhojpuri.

Clicking on the module icon brings the user to the second level of the site, where the screen is split into three frames. A side menu enables the user to switch to any of the nine
information modules described above (depicted as television channels) while another ‘picture’ frame displays pictures relevant to the different topics described within the module. The main section of the screen presents the topics available in the form of graphical icons, with audio files describing the kind of information they contain.

The user has to choose one of the topics to access detailed information. At the level of each topic, information is provided in English text, as obtained from official recommendations from the agricultural institutions. The illiterate user also has the option of clicking on a graphical icon which will ‘read’ a summary of the contents of the page in a local language. Clicking on the icon of a camera within the text a paragraph will display a related illustration in the picture frame. For some topics, the main frame is split into two to display subtopics. Audio files are present at these levels too, but not at deeper levels in the web site, where technical and scientific information are presented and where an illiterate user would require assistance.

**Evaluation of PETIS**

Large-scale growers (n=7), small-scale growers (n=40), and extension officers (n=12) were asked to rate the order and grouping of information, the use of graphical icons, pictures, and audio files in the information system, on a scale of 1-10 (poor – excellent). Both small-scale and large-scale growers gave highest ratings to the use of audio files and pictures (Table 1). In general, small-scale growers gave higher ratings to the interface features of the information system than large-scale growers did. Extension officers gave the lowest ratings but which were still high. The mean rating, for all users combined, for the four features listed were not significantly different, indicting that they contributed equally to the user-friendliness of the interface.

<table>
<thead>
<tr>
<th>Screen design Parameter</th>
<th>Extension officers</th>
<th>Mean rating ± standard error</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Small growers</td>
<td>Large growers</td>
</tr>
<tr>
<td></td>
<td>Mean rating ± standard error</td>
<td>All users</td>
</tr>
<tr>
<td>Audio files</td>
<td>6.90 ± 0.344</td>
<td>8.70 ± 0.271</td>
</tr>
<tr>
<td>Ordering and grouping of information</td>
<td>7.52 ± 0.214</td>
<td>8.13 ± 0.254</td>
</tr>
<tr>
<td>Pictures</td>
<td>6.57 ± 0.272</td>
<td>8.45 ± 0.251</td>
</tr>
<tr>
<td>Graphical icons</td>
<td>7.00 ± 0.285</td>
<td>8.40 ± 0.330</td>
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Each category of users found that PETIS satisfied specific information needs to different extent (Table 2). At least 70% of growers believed that PETIS improved timeliness and relevance of information for decision-making, saved time in the search for information by integrating information from different sources and would enable better cultural practices. PETIS was also highly rated as a tool to educate novice growers and extension agents about potato production. Growers also realized that better access to information might not necessarily lead to higher income from potato production.
Large-scale growers, small-scale growers, and crop extension officers respectively gave an overall mean rating of the information system of 8.43, 7.97 and 7.05, on a scale of 10. Following the presentation of PETIS to the audience and some hands-on practice, 70% of potential users, including more than half of users with low computer skills, believed they could use the system after only three hours of training.

### Table 2 Usefulness of PETIS as rated by different groups of users

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<tr>
<th>Usefulness of PETIS</th>
<th>% Response</th>
<th>Agree</th>
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<tbody>
<tr>
<td>1. More timely and relevant information will help in better decision-making.</td>
<td>85.7</td>
<td>87.5</td>
</tr>
<tr>
<td>2. The integration of different sources of information will save time as there is less need to move</td>
<td>71.4</td>
<td>87.5</td>
</tr>
<tr>
<td>3. It will enable better cultural practices (pest &amp; disease control, earthing up, etc)</td>
<td>85.7</td>
<td>75.0</td>
</tr>
<tr>
<td>4. Can be used as a training tool for novice growers/office</td>
<td>100.0</td>
<td>67.5</td>
</tr>
<tr>
<td>5. Higher economic gains will be achieved</td>
<td>42.9</td>
<td>50.0</td>
</tr>
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</table>

**DISCUSSION AND CONCLUSIONS**

The small-scale potato growers’ community is an aging one, of which 80% have completed at least primary school and which prefers to communicate and obtain information through the two local, non-written languages. In their quest for more timely, accurate, and relevant information, most of the growers were willing to use a computer-based information system if it were easy to use. Although only 25% of them currently had direct access to computers, 80% of growers believed they could benefit from a computer-based information system either directly or indirectly through intermediaries. Extension officers, two thirds of whom are computer literate (Bheenick & Brizmohun, 1999) can further help growers benefit from PETIS. The availability of free multimedia access to the Internet at community centers around the country will further enhance accessibility of the information system.

The high rating of PETIS by potential users indicates its potential as a model for future computer-based information systems locally. The main features appreciated were the use of graphical icons, audio support and the integration of information from various sources in one location. The trust of the growers in the system may be due to the sense of ownership developed though their participation in the development of the information system: a factor that should be an important consideration in future projects of this kind.
This study has provided an opportunity to address several issues on the application of Information Technology, especially the web, in the agricultural sector, and some of the lessons learned are presented below:

**a. Information Technology can supplement current extension methods**
The preliminary information needs assessment demonstrated that current extension methods usually based on individual and group meetings and using printed documents, needed to be improved upon. Potato growers differed in terms of the amount, complexity and form of information needed. However, there is a high demand for information that is dynamic, such as information on technical innovations, prices of inputs and impact of price changes. No increase in human resources would be sufficient to satisfy these information needs in an environment where communication occurs orally and necessitates personal contact. As demonstrated in this study, Information Technology offers several advantages over the use of printed materials in such circumstances. A well designed information system can store a large amount of information and present it in various forms appropriate for different users, including illiterate users, and which can also be updated without substantial cost and effort.

**b. Farmers’ information needs are difficult to satisfy completely, but technology helps!**
Although an information needs assessment was carried out at the start of the project, new issues and queries were brought up at the evaluation stage of the information system. These new queries either indicated that the information requirements had not been properly defined or demonstrated the dynamic nature and evolution of information needs of growers, who had more queries once they had accessed the information system. PETIS satisfies the basic information needs of growers who may still go to the extension officer for specific information, if available. Therefore, the information system enables extension officers to focus on the immediate and more complex needs of the growers. New questions arising from the growers’ community can be addressed rapidly by updating the computer-based system with responses to the new queries and making them available to all, hence improving the rate of dissemination of information and increasing the value of the system.

**c. A computer user interface for use by illiterate users**
This study has demonstrated that graphical icons can be used to depict agricultural practices on a computer-based information system. The use of such graphical icons can overcome the illiteracy or language barrier, especially if accompanied with audible explanations. The apparent user-friendliness of the system is demonstrated by the fact that after a presentation of the system and some hands-on practice, most of the potential users were confident that they could use the system after a short training session. The use of graphical icons could potentially be expanded to cover the range of agricultural practices locally and could also be used in print media to facilitate communication and information dissemination. The possibility of using animated icons on computers offers the potential to develop such icons usable at both the national and international level. The skills required to use the system are simply to use a mouse to point and click at objects on the screen. The popularization of touch screens may even do away with the need for the user to operate a mouse to navigate within the information system in future.
d. A low cost of development for the multimedia information system interface
The incorporation of sound files within a web interface is easily accessible to computer users and is feasible with minimum technological investment. Computers manufactured in the last five years have the capacity to accommodate multimedia systems connected to a microphone. Alternatively, the output connection from most audio cassette players can be plugged into the sound card to record the audio content. The size of the audio files used in PETIS were limited to less than 1 MB, to facilitate the transfer of information through floppy disks, but also to ensure timely download over the Internet. The modular structure also allows for links to audio files to appear at the end of relevant sections of text, and facilitates updating. As technology improves, video capture may also become a standard feature of multimedia computers and enhance communication of information. However, video transmission is not suitable for low bandwidth Internet connections typical in developing countries.

EDUCATIONAL IMPORTANCE
This study has demonstrated the feasibility of designing an information system that enables an illiterate person to have access to information on the World Wide Web, using readily available technology. The results of this study also open up a new area of research in Agricultural Extension and Education, focused on the applications on Information Technology in the non-formal educational sector. Experience acquired in the design and delivery of web-based Distance Education may be relevant. Further research is required in this area to determine the effectiveness of such information systems at improving the decision-making skills and problem solving skills of agricultural producers.

REFERENCES

