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ADOPTION OF INTERNET APPLICATIONS
BY SUGARCANE FARM BUSINESSES IN THE
KWAZULUNATAL MIDLANDS**

by

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Abstract

Regression analysis is used to delineate significant determinants associated with the use of Internet applications by commercial sugarcane farm businesses in the KwaZulu-Natal Midlands. Eighty-six percent of farm businesses surveyed had Internet connections and 83 percent used Internet applications (including e-mail, on-line banking and gathering information from the World Wide Web) for business purposes. Results indicate that significant determinants of the range of Internet applications by farm businesses include a) the period of time for which the farm business has been connected to the Internet, b) the principal farm decision-maker's education, time available to spend on the Internet and his or her perceptions of the Internet as a source of information, and c) characteristics of other farm computer users. Activities that may promote use of the Internet applications by farm businesses include the development of policies and software to reduce risks of Internet use, and improving the Internet skills of farmers.

1. INTRODUCTION

The Internet has been identified as a tool that can be used to improve efficiency in the agricultural sector (Gloy and Akridge, 2000). Its spectrum of on-line information-intensive and communication-intensive applications raises the potential for improved forms of information transfer and market relationships within agricultural supply chains (Sonka and Coaldrake, 1996). Potential uses of the Internet for farm businesses include "to access price and product information, access government and university reports and research, interact with other producers and specialists, purchase inputs, sell production, communicate with suppliers and customers and access application software." (Gloy and Akridge, 2000: 323). Porter (2001) contends that survival in business without being connected to the Internet will become almost impossible in future.

In South Africa, it is becoming commonplace to encounter farm businesses that use on-line applications. Previously researchers (e.g., Bown *et al.*, 2000) have reported on the incidence of Internet connections amongst South African farm businesses, and Darroch (2001) studied factors affecting adoption of the Internet by game-ranching businesses in north-eastern KwaZulu-Natal. The contribution made by this study is to assess farmers' perceptions of the Internet as a business tool, and to delineate significant determinants associated with the use of Internet applications by farm businesses. The empirical analysis was conducted using data elicited from a sample of sugarcane farm businesses in the KwaZulu-Natal Midlands. Findings assist with identifying activities that are expected to facilitate the up-take of on-line applications by South African farm businesses.

2. ADVANTAGES AND LIMITATIONS OF THE INTERNET

Personal computers are currently a requirement for the adoption of the Internet; however, these two technologies are very different (Gloy and Akridge, 2000). Computers are used to manipulate internal data and provide information for management decision-making purposes, while the Internet is a source of communication and external information (Lewis, 1998).

Benefits of the Internet over previous information and communication technologies include that its applications may be used asynchronously, i.e., farmers can browse the World Wide Web, pay their accounts, download software or communicate through e-mail when their opportunity cost of time is at its lowest. Porter (2001) contends that the Internet can be an effective tool due to relatively low initial investment requirements relative to other technologies. This makes it accessible to small businesses as well as large businesses.

The Internet lends itself to quick, relatively cheap and easy dissemination of information (Henderson *et al.*, 2000), and therefore may reduce transaction costs of communicating, transacting and sourcing information. With improved information and knowledge, individuals' perception of products and services provided would be more accurate, thereby improving the adoption of worthwhile technologies and discarding those that have little value (Hooker *et al.*, 2001; Just and Just, 2001). Farmers could use the Internet to obtain very general information or to access sites that provide specialized information for their individualized needs. Web sites such as SAFEX, Agrilink, Agriinfo and Agrimark Trends are available and provide information and communication possibilities for South African farmers (Ortmann, 2000).

Information placed on the Internet may be made publicly available or remain private (Sonka and Coaldrake, 1996). Firms may therefore place confidential information on the Internet, confident that only intended persons can access the information. This may lower costs of providing personalized, on-time information (Mueller, 2001).

Finally, the Internet is a technology that faces strong network effects, which have been described as "the value of a good changing because of the number of people using the good change" (Liebowitz and Margolis, as cited in Mueller, 2001: 1247). Increased traffic on the Internet brings about faster information dissemination and more e-commerce taking place. Thus, the value of the Internet would increase as more people begin using it to facilitate their current business (Mueller, 2001). In South Africa, as in other countries, rural Internet connectivity is still a problem (Ortmann, 2000), implying that the network effects of the technology are not yet realized completely in the rural economy. In a study conducted in South Africa in 1999 it was found that 38% of large scale commercial maize farmers had access to the Internet, even though 72% of respondents had adopted personal computers (Bown *et al.*, 2000).

Limitations of the Internet include the inability to physically transact, thereby making personal bargaining and sales skills unnecessary. Similarly, if the customers wish to touch, feel or smell products, the Internet is unable to provide these types of functions. Other problems, such as delays in navigation on the Internet and logistical problems of

packing and shipping small quantities (Porter, 2001), all add up to reasons why traditional markets are sometimes preferred.

Whilst trading on the Internet, it is impossible to be sure of the trading partner's identity. Because there is a certain amount of trust involved in trading, uncertainty of the other's identity could diminish trust and therefore reduce chances of transactions occurring (Mueller, 2001). Absence of formal as well as informal laws could pose a problem due to the inability to enforce contracts, thus the risk of transacting on the Internet is increased and reduced traffic would be experienced (Mueller, 2001).

Adverse economic effects can arise with the adoption of the Internet becoming more widespread. As Internet transactions increase, the possibilities to evade detection by authorities increase. For example, the under-representation of data could lead to the loss of sales tax revenue (Just and Just, 2001).

3. FACTORS AFFECTING FARMERS' INTERNET USE DECISIONS

Factors affecting farmers' decisions to use Internet applications are expected to be similar to those that affect their Internet adoption decisions. These factors include characteristics of the farm business as well as characteristics of the principal farm decision-maker. Gloy and Akridge (2000) found that for a sample of large US farm businesses the likelihood of the business being connected to the Internet was higher for larger farm businesses that are intensively managed and planned, and if the farm decision-maker was younger, better educated, and did not participate in physical labour on the farm.

The probability of Internet use is expected to decline with the age of the computer operator. Older individuals are expected to be more experienced in farming and thus value the information that can be attained from the Internet less than younger farmers who have less experience (Gloy and Akridge, 2000). Also, older people have less time to retirement, thus less time to experience the benefits of their investment (Darroch, 2001). Finally, younger farmers are likely to have had relatively more exposure to computers and the Internet and are thus more confident in their abilities to benefit from them.

More educated people are expected to adopt the Internet more readily because they may have had greater exposure to it, and it is anticipated that information would be more useful to them. Gloy and Akridge (2000) found that only when individuals reached masters level tertiary education did education level become important. Thus, it appears that high levels of education must be attained before the full benefit of information gathered on the Internet becomes valuable. More educated people possibly have different information requirements to less educated people and intense management and planning requires more external information which is obtainable from the Internet.

Size of the business is an important factor when considering adoption of new technologies. Businesses with greater output are able to spread adoption costs of new investments over more units of output, thus making it cheaper per unit of output than for smaller farmers (Darroch, 2001). A weak statistical relationship between farm size and

Internet use was reported by Gloy and Akridge (2000). This could be an indication that the Internet is becoming an essential input in production. If the input becomes essential then large and small farmers would need to adopt the technology in order to continue operating efficiently.

Farmers with a higher opportunity cost of time may benefit relatively more from using timesaving Internet applications. Consequently, it is expected that farm businesses with more intensive management plans and those whose principal decision-makers have off-farm employment may use a greater range of Internet applications. However, it may also be argued that farmers who are less easily able to find time to spend on the Internet (e.g., those with off-farm employment, those who operate an off-farm business, and those who participate in physical labour on the farm) are likely to use fewer Internet applications.

Finally, the decision-maker's perceptions of the Internet and its applications influence Internet adoption and Internet use decisions. Obtaining information about production inputs and having knowledge of what is available in the market is a means of reducing risk (Sonka and Coaldrake, 1996). In the early stages of a new technology it could be perceived that it is advantageous to postpone adoption because learning from early adopters' mistakes could prove valuable (Hooker *et al.*, 2001). Perceptions of improved efficiency lead to the implementation of the technology (Henderson *et al.*, 2000). Costs are easily observable but benefits are not as straightforward because of the indirect nature of the benefits. The "inability to see returns to the cost of converting" (Hooker *et al.*, 2000) is another contributing factor to slow adoption. It follows that farm businesses that have been connected to the Internet for longer are expected to make use of relatively more Internet applications.

4. THE SURVEY AND DESCRIPTIVE STATISTICS

Commercial sugarcane farm businesses in the KwaZulu-Natal Midlands were selected as the study population for this research. Approximately 17% of the 412 000 hectares under sugarcane production in South Africa are found in the KwaZulu-Natal Midlands (SASA, 2002). Two mills are located in this region. One-hundred-and-ten large-scale growers and 28 small-scale growers supply the Union – Cooperative mill at Dalton with approximately 1.045 million tons of sugarcane annually. The Illovo mill at Noodsberg has an annual crush of about 1.382 million tons of sugarcane. One-hundred-and-seventy-four large- and medium-scale growers deliver to this mill as well as 603 small-scale development growers (Bee, 2002).

A list of all commercial sugarcane farm businesses in the region was compiled from information provided by the Noodsberg and Dalton sugar mills. A sample group of 40 farm businesses for the survey was randomly selected from this list using a random number set. Farmers included in the survey were drawn from the Kranskop, Wartburg, Fawnleas, Dalton and Pietermaritzburg areas. Large and small-scale commercial sugarcane farm businesses were selected, with growers that deliver less than 459 tons of sucrose per year being classified as small-scale growers. Thus a wide spectrum of farm businesses and farming areas was reached. Questionnaires were hand-delivered to these

businesses during July 2002. Personal contact was made telephonically with the principal decision-maker of each business to explain what the study was about, and what was required of him or her. Thirty-seven of the 40 farm businesses returned survey questionnaires (a response rate of 92.5%), of which 35 were usable.

The average age of respondent principal decision-makers was 45 years with an average farming experience of 20 years. The majority of respondents were highly educated - 71.4% had attained a qualification beyond Matric (diplomas, bachelor degrees and masters degrees, or a certificate in a trade). About 11% of respondents had off-farm employment and 17% managed off-farm businesses. Over one-third of respondents (34%) operated as sole proprietors, with the second most popular farm business ownership structure being partnerships (31.4%).

The average area operated among the respondents was 638ha, but the range of farm sizes was large – from 26ha to 2000ha – with a mode of 240ha. Twenty-nine percent of farm businesses rented in land, with the mean area rented being 62ha. An average of 321ha were planted to sugarcane, with an average crop of 14 809 tons per annum and a yield of 92 tons per hectare harvested. Sugarcane under dryland conditions in the study region is harvested at an age of 18 – 24 months.

The average turnover was R3.38 million with a median of R3.1 million. The range of annual farm turnover was from R70 000 to R8.5 million. On average, gross income from sugarcane comprised 73% of total turnover. Eighty percent of the surveyed farmers received more than 50% of their turnover from sugarcane. On average, 56 permanent and 15 casual (seasonal) labourers were employed on each farm. Managers were employed on about 31% of farms. Enterprise diversification occurred on 88.6% of farms surveyed. Nearly two-thirds of surveyed farm businesses produce wattle as an additional enterprise. Other enterprises were pine (48.6%), eucalyptus (28.6%), beef cattle (28.6%), vegetables (20%), flowers (8.6%), and dairy (5.7%).

About 97% of respondents owned personal computers and used them for farm related activities. These included farm-record keeping, word-processing, and calculation of cane estimates and wages. Recent increases in computer adoption on South African farm businesses can be attributed to increased perceived benefits, lower costs of computer hardware and software, and easier-to-use computer software packages (Ortmann, 2000). About 71% of the respondents operated their PC themselves, while the remaining respondents indicated that their spouses, children or employees operated the computer. This suggests that a large proportion of principal farm decision-makers are computer literate.

Thirty of the thirty-five survey respondents (86%) had Internet connections. On average respondents had been connected to the Internet for four years, however this ranged from one year to nine years. Twenty-seven respondents (77%) considered the Internet to be useful to their farm businesses in one way or another, while 25 respondents (71%) alleged that they felt confident in their ability to use the Internet. Sixty percent of respondents perceived the Internet to have safety and security problems. Respondents

were most likely to go on-line during the evening (63%) or morning (50%) and least likely during the afternoon (3.3%).

Twenty-nine of the 30 farm businesses connected to the Internet use Internet applications for business purposes. All 29 of these businesses used the Internet for e-mail, 25 for banking and 21 for sourcing information on the World Wide Web. Six respondents used the Internet for e-mail and banking but not for gathering information on the Web; two used the Internet for e-mail and for gathering information on the Web but not for banking; and two used the Internet for email only. Only six respondents indicated that they have made purchases over the Internet, including books, computer software, equity shares, videos, tickets, incubators and fishing tackle. In general, respondents did not rate the Internet highly as an information source and only four respondents reported a reduced reliance on other information sources subsequent to being connected to the Internet. This suggests that whilst e-mail is almost an inherent function of connecting to the Internet, a significant proportion of farmers lack familiarity with the potential value of other Internet applications.

5. THE STATISTICAL ANALYSIS AND RESULTS

It was initially intended to use information elicited in the survey to identify factors affecting Internet adoption by using Discriminate or Logistic Regression models to discriminate between adopters and non-adopters (i.e., analyses similar to those by Gloy and Akridge (2000) and Darroch (2001)). The high incidence (86%) of Internet connections amongst farm businesses surveyed precluded this analysis due to the limited data on non-adopters. Instead, OLS Regression was used to identify factors that explain why some farm businesses use more Internet applications than others.

The dependent variable, USE, was defined as the number of Internet applications used by the farm business for business purposes. Three Internet applications were considered, namely e-mail, banking, and sourcing information from the World Wide Web.

Several explanatory variables were considered in the analysis. AGE is defined as the principal farm decision-maker's age in years; and PCUSER is a dummy variable equal to one if the principal farm computer-user is not the principal farm decision-maker but instead his son or daughter, otherwise zero. Education is included in the model using a dummy variable, EDU, which is equal to one if the principal farm decision-maker has a tertiary qualification (diploma, bachelor degree or masters degree), otherwise zero. SIZE, defined as the total area of the farm in hectares, is included to capture the effects of economies of size on Internet use decisions. Three variables were included in the model to capture the effects of management time on Internet use decisions: LABOUR is defined as the farm business' number of permanent employees, whilst CONTR and EMPL are dummy variables equal to one if the principal farm decision-maker has an off-farm contracting business or off-farm employment respectively; otherwise zero. A Principal Components Analysis was used to construct orthogonal indices of farmers' perceptions of the usefulness of the Internet for gathering information. The Principal Components, INFO₁ and INFO₂, are positively related to farmers' perceptions that the Internet is useful

for sourcing market price information, and that the Internet is useful for sourcing general farm information, respectively. TIME is defined as the number of years for which the farm business has been connected to the Internet.

OLS regression analysis was conducted using the SPSS statistical package. Variables not significant in explaining variation in USE at the 15% level of statistical probability were excluded from the model. The following regression equation was estimated:

$$\text{USE} = 1.040^{***} + 0.467^{**} \text{TIME} - 0.037^{*} \text{TIME}^2 + 0.420 \text{EDU} + 0.249^{*} \text{INFO}_2 - 0.807^{***} \text{CONTR} + 0.731^{**} \text{PCUSER}.$$

$$R^2 = 0.711 \quad \bar{R}^2 = 0.632 \quad F = 9.009^{***} \quad df = 22$$

Where, ^{***}, ^{**}, and ^{*} denote significance at the 1%, 5%, and 10% levels of statistical probability, respectively.

The estimated model exhibits good fit of the data and accounts for over 71% of variation in the number of Internet applications used for business purposes by survey respondents. The constant term is approximately equal to one, reflecting that farm businesses that use the Internet for business purposes all tend to use e-mail. Results further indicate that the longer a business has been connected to the Internet, the range of Internet applications used for business purposes increases at a decreasing rate. This reflects that it takes time for new users to become familiar and confident with on-line application such as banking and searching for information on the Web.

Although the relationship estimated between the principal decision-maker's level of education and the number of Internet applications used was positive, it was statistically significant at only the 12% level of probability. Likewise, no discernable relationship was found between the principal decision-maker's age and the number of Internet applications used by the farm business. These results perhaps reflect that only 71% of respondents are computer users on their farm businesses. Future studies on the use of computers and the Internet by farm businesses should also consider characteristics of the farm computer users as well as characteristics of the principal farm decision-maker. For example, the statistically significant coefficient estimated for PCUSER indicates that on farm businesses where the farmer's son or daughter operates the farm computer, a greater number of Internet applications are used for business purposes.

Farmers who operate contracting businesses have less time available for using the Internet, and consequently tend to use fewer Internet applications. The absence of a statistically significant relationship between off-farm employment and the number of Internet applications used perhaps reflects that although off-farm employment decreases farmers' time for using the Internet, these farmers may use timesaving Internet applications because their opportunity cost of time is high. Further, off-farm employment may, in some instances, lead to farmers being more familiar with using the Internet.

Farmers' perceptions of the Internet were found to be important in their Internet use decisions. Farmers who perceive the Internet to be useful for gathering general farm information and for finding better deals are more likely to use more on-line applications. However, the relationship between farmers' perceptions of the usefulness of the Internet for gathering information on products and market information and their use of Internet applications was not found to be statistically significant. This may be indicative of supply and marketing arrangements within the South African sugar value chain that reduce the need for sugarcane farmers to search for market related information.

Finally, results indicate that economies of size are not important in determining the range of Internet applications used by a farm business in this study. This reflects that once the fixed costs of connecting to the Internet are incurred, the fixed costs of using additional Internet applications (e.g., on-line banking) are relatively low.

6. DISCUSSION AND CONCLUSION

Results of this study suggest that the incidence of Internet connectivity by South African farm businesses is increasing. Although e-mail communication remains the primary application for farmers, use of other Internet applications is increasing over time. Problems possibly include that the mixed bag of standards, file types, categories, etc., have made it difficult for farm businesses to find quality information, to take it and to integrate it together into a resource useful to the business.

Despite the high incidence of Internet connectivity amongst the surveyed businesses, there is evidence that many sugarcane farmers lack familiarity with the potential value of Internet applications. It is difficult for people inexperienced in using the Internet to accurately anticipate the value of being able to access, analyse and interpret massive quantities of explicit information. It is important to find activities and policies that will promote use of Internet applications on farm businesses in order that the networking effects of the Internet are realized in the rural agribusiness economy. These include the development of policies and software to reduce risks of Internet use. Further, an improvement in Internet skills of farmers is required to hasten the evolution in information technology on South African farm businesses.

Finally, the dependent variable used in this analysis does not reflect the intensity with which Internet applications are used by farm businesses. Future research on this topic should address this dimension of Internet adoption. Further, it is recommended that future studies on computer and Internet adoption by farm businesses should take cognisance that the principal farm decision-maker is not necessarily the principal computer-operator of the farm business.

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