New Zealand Farm Computer Users - Their Maturing Attitudes and Characteristics

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1. Introduction

Micro-computers were first introduced around 1980. Compared to previous computers they were relatively inexpensive and had similar computing power.

For farm use the logic was that the data and information storage, computational and analytical, as well as retrieval attributes of computers made them ideal support equipment for decision-making and recording (and associated form filing). Thus, it was a matter of cost - once the cost declined sufficiently it was inevitable that farmers would take on these machines.

It is particularly the case in primary production that computers will enhance efficiency as communication with banks, markets, and suppliers will be improved despite the physical distances. The service industries are tending to force businesses to become computerised and thus to remove the need for expensive and time-consuming people and paper-based transactions.

The computer has created a major shift in the technology of living and management. Thus, it is crucial to monitor its current impact so that future activity can be appropriately directed. Correctly used the potential for enhancing efficiency is significant. This study is directed at assisting this process.

A 1998 survey designed to examine the changing computer scene is described. The sections contain information on computer ownership, details of the computer users, information on the functions they are used for, attitudes of the users to computing, details of Internet use, and, finally, a discussion on the nature of farmers relative to their objectives.

The data obtained is related to earlier similar surveys. In 1990 (Nuthall, 1992) data from 639 computer users and 1,063 non-users was obtained. In 1993 (Nuthall and Bishop-Hurley, 1994); 1,042 valid responses were obtained from 3,097 postings. In the current survey 1,437 valid responses were obtained from the 3,021 randomly selected stratified sample (49.5% response). This unique sequence of data enables valuable comparisons.

As at mid-April 1998 42.72% of the sample had a computer. This compares with 6% in 1986 (Pryde and McCartin, 1987) and 24.40% in 1993 (Nuthall and Bishop-Hurley, 1994). In five years the increase has been 18.32% (3.66%/year) whereas in the previous seven years the increase was similar in total (18.4%, 2.63%/year). It is suspected the current rate will continue for some years.

2.   Social factors

Surprisingly, there appeared to be little difference between the stated objectives of computer and non-computer using property managers. Table 1 contains the average score given to each objective listed in the questionnaire on a 5 (very important) to 1 (not important) scale.

Table 1

Average ranking of managers' objectives
(1 [not important] to 5 [very important] scale)

Objective	Computer Farms	Non-Computer Farms
To be the best farmer/producer	3.27	3.30
To be the most productive	3.61	3.54
To make as much money as possible	3.87	3.77
To enjoy farming	4.29	4.37
To provide an income to raise my family	4.23	4.22
To have a reasonable income and plenty of time to enjoy other interests.	3.86	3.95

None of the slight differences were statistically significant. It is clear enjoyment of farming and family issues are important. This is typical of the conclusion in previous studies (e.g., Fairweather and Keating, 1990).

In contrast, the difference in the average age of the farmers was highly significant. The managers on 'computer farms' averaged 45.69 (43.29 in 1993) years while the others were 50.5 (45.65 in 1993) years - a difference of five years. This difference is more marked compared to the 1993 survey where the difference was only 3 - 4 years. Perhaps those that did not have a computer largely still have not purchased, but new younger farmers have tended to purchase.

Most farm computers are operated by more than one person - the main 'other user' had an average age of 31.15 years suggesting the younger generation is providing support. Most computer using managers have similarly been farming for a smaller number of years (23.25 years) than their non-using counterparts (29.21 years). This difference is statistically highly significant.

There is also a clear difference in the formal education levels of the two groups. In presenting this data the computer users' information for both the 'main' and the 'other user' education levels are presented. See Table 2.

Table 2

Highest formal education level
(column percentages)

| | Computer Users | | | Non-Computer Farmers | |
| | Main User | | Other User | 1993 | 1998 |
Level	1993	1998	(1998 only)		
Primary or less	1.3	0.98	2.96	4.7	3.16
Secondary - ≤ 4 yrs	45.3	47.22	31.58	63.0	63.86
Secondary - > 4 yrs	15.3	14.59	22.37	8.8	13.27
Tertiary - ≤ 2 yrs	19.3	17.05	17.76	11.2	11.17
Tertiary - > 2 yrs	18.8	20.16	25.33	12.3	8.54

The Chi square test indicated the differences were highly significant. Thirty-seven percent of main computer users have tertiary experience, and 43% of the 'other user' have this experience compared with 20% of the non-users. This difference is marked. The 1993 figures are very similar.

There are clear relationships between computer ownership, age, education and business size. For the 1993 data a logit analysis provided the equation (with Tau-c = .621):

$$\log \left(\frac{P_i}{1 - P_i} \right) = .3048E_i + .0704S_i - 2.9159$$

Where P_i is the probability of the ith farmer having a computer.

E_i is the education level of the ith farmer on a 1 to 5 scale.

S_i is the size code of the ith farm based on the equivalent number of sheep it can support (1 = <1000 sheep ..... 15 > 14,000 sheep).

The previous tables show the importance of these variables in the 1998 data. Eventually these relationships in which the more educated, younger managers of larger properties having computers must weaken as the penetration percentage increases.

The average age of all farmers in 1998 was 48.37 years relative to 44.72 years in 1993. There is not a five-year increase indicating the retirement/recruitment process is markedly different from a balanced situation. Perhaps this reflects a poorer outlook for retired people maintaining a reasonable standard of living. For the education levels across all farms there is a clear tendency for the second user of the farm computer (mainly a spouse) to have a higher level of education (score of 3.31 relative to 2.79 on a 1 to 5 scale with 1 representing only primary education).

There also appears to be a slight increase in the education level in 1998 (2.79 score) compared to 1993 (2.69 score) despite the low turnover rate of managers.

The portion of total income obtained from farming is similar for both computer owners and non-owners. The figures are 84.2% and 86.38% for the users and non-users respectively. The slight difference is not statistically significant. These are, of course, average percentages.

3. Ownership Details

It is useful to examine length of ownership, and farmers' purchase expectations as well as age and education aspects of years of ownership. The following table presents this data.

Table 3

Time to purchase a computer (non-owners)
AND years of ownership (current owners)

No. of Years	Percentage of non-owners		Percentage of 'Current' owners	
	1993	1998	1993	1998
≤ 1	8.0	10.57	25.5	0.9
1.1 to 2.0	9.2	14.09	10.8	22.9
2.1 to 3.0	5.6	4.58	15.4	23.8
3.1 to 4.0	2.8	2.99	7.9	17.5
4.1 to 5.0	8.2	7.57	10.0	13.9
5.1 to 6.0		0.35	9.6	7.6
6.1 to 7.0		0.53	4.6	
7.1 to 8.0	3.2	0.18	6.7	7.9
8.1 to 9.0		0.0	2.1	
9.1 to 10.0		1.24	5.8	
> 10.0			1.6	5.5
Don't Know	14.1	-		
Never	48.6	57.9		
Mean yrs to buy	3.3	4.3	-	-
Mean yrs of ownership	-	-	4.1	5.7
Percent Non-Owners/Owners	75.60	57.28	24.40	42.72

There are some inconsistencies with these figures in that the percentage indicating they will purchase is greater here than the number indicating they will purchase soon when asked why they did not have a computer. The reality is that more people have purchased, and continue to do so, than might originally have been anticipated. Furthermore, as noted, there are clear links between size of business, education and age. With time, business size will probably grow and education levels rise, and, as generations pass, the increasing computing familiarity that is started at most primary schools will mean age is no longer a factor. Thus, uptake rates are likely to continue.

It is interesting to compare the 1993 retention figures with the actual 1998 years of ownership figures. In 1993 17% said they would purchase within two years. Looking back in the 1998 figures it can be noted 17.5% have had a computer for approximately four years. Also note the 'never purchase' figure has now increased, but of a decreasing pool of non-owners.

Table 3 also contains the distribution of owners' experience in terms of the number of years they have had a computer. The increasing number purchased each year is clear, but perhaps the rate of increase has stabilised. The average age of computers is 3.78 years indicating many have updated. However, some 35% have a computer seven or more years old. It is clear that the software and systems of those days continue to provide the information required. Indeed, many would argue that while the software produces very different screen arrangements and while the operating systems have changed in appearance and ease of use, the basic functionality has not changed markedly. It is suspected once a farmer learns a package he/she is reluctant to take on a new system requiring a re-learning time input. Despite this 25.31% did note they are CONSIDERING an upgrade over the next year.

Relating length of computer ownership to social factors (see Table 4) indicates the early innovators had a higher education level and were perhaps a little younger when they first acquired a computer compared to recent purchasers. This is to be expected. There is little difference in their objectives.

(The objectives have been grouped into three broad categories - *production*, combines 'best farms/producers', and 'most productive'; *money* combines 'make as much money as posible' and 'provide income to raise my family'; *enjoyment* combines 'enjoy farming' and 'reasonable income and plenty of time to enjoy other interests'.)

Table 4

Managers' characteristics relative to length of computer ownership

	Length of Ownership in Years			
	≤ 2 yrs	2+ to ≤ 4 yrs	4+ to ≤ 6 yrs	> 6 yrs
Average age (years)	44.11	44.84	45.19	47.32
Average education score *	2.86	3.02	2.98	3.36
Objectives based on a 10 (very important) to 1 (not important) score +				
Production	6.88	6.62	7.26	6.72
Money	8.13	7.97	8.35	8.02
Enjoyment	7.93	8.23	8.19	8.25 #

\# $t^2 = 34.185$ p $= 0.025$, other differences not significant.
* Based on a 1 to 5 (highest) score.
\+ See Table 1 for details.

NOTE - The average age differences were nearly significant (p = .066).
        - Education score differences were not significant

For the farmers without a computer, there is little difference in the average education levels (the younger people have slightly higher education) according to years until expected purchase. However the ages for each group are markedly different in that where the intention is to purchase in less than two years the average age is 50.95 years, in 2-5 years 43.06 years, and in greater than 5 years 37.44 years (difference highly significant). Surprisingly the older farmers expect to purchase sooner in contrast to the lower average age of existing owners. The explanation is not clear. Also surprisingly, the farmers who will wait over five years before purchase appear to have a greater interest in the 'money' as an objective than the others (perhaps 'thrift' is crucial to them?).

4. Computer Use

Farm business computing is the most dominant use of the computer taking 56.59% on average of the time. However, leisure use at 17.46% is also important. The remaining time is spent on learning and education (12.96%) and off-farm business activity (12.98%).

There is quite a wide range of levels, however, with some 33% spending nothing else but 81-100% of computing time on farm business computing, and at the other extreme, 16.76% are in the 0-20% range of time on farm business computing. Overall, the distributions are flat indicating the wide range of levels of each activity.

For business type activities, Table 5 contains the average hours spent using various packages.

Table 5

Time spent on business computing functions

Function	No. Users	Average Hours per Month	
		Over-Users of Each Function	Over all Users
Word processing	363	7.52	5.34
Spreadsheet	232	5.40	2.45
Database	133	5.68	1.48
Financial & Accounting	386	7.69	5.81
Production Records	203	4.84	1.92
Computer-aided Drawing	42	7.48	0.61
Communication	117	6.36	1.46
Electronic Banking	54	4.29	0.43
Other	32	22.34	1.40
			20.90 hrs/month 4.81 hrs/week

The importance of word processing, financial and accounting activity is clear, though for some users other activities are very important - for 42 users, for example, computer aided drawing uses many hours of attention. For software developers it is clear where most of their effort should go - financial management systems, though they must not forget that interest exists in production records. Integration between packages must be an emerging problem as users' tastes mature and they investigate more than the basics.

The farm manager is the main user of the computer, but his or her spouse is also an important user, and in some cases is the main user. Table 6 contains both these proportions as well as the percentage of the potential users that carry out various functions.

Table 6

Business computing by type of user

	Farm Manager	Manager's Spouse	Farm Worker*	Adult Family	Children
Percentage of total use	48.85	29.65	1.74	6.59	13.16
Percentage doing at least some of:-					
Financial records	70.9	65.41	27.78	36.71	2.00
Financial budgets	59.59	30.83	27.78	21.52	0.0
Performance records	34.01	13.53	44.44	12.66	1.33
Stock production	32.27	12.41	11.11	7.59	1.33
Feed budgets	17.73	5.26	11.11	7.59	0.0
Letter and report writing	48.84	79.93	55.56	64.56	58.67

* Includes Secretarial Staff

Farm children provide a useful supporting role in that they provide 13.16% of total business computing, but this is mainly word processing in that nearly 60% are involved in this function. For the major users, the manager and her or his spouse, it is only in the financial recording area that more than 60% become involved. Nearly 60% of managers carry out financial budgeting, but nearly 80% of spouses use the word processor. The pattern, therefore, is both the manager and spouse being involved in the financial recording, the spouse and children writing letters and reports, with the manager being the planner (budgeting). Software developers, but more importantly, groups responsible for education and training, must take into account the complexity of these user arrangements.

Of the approximately 20 hours spent on business computing each month, 4.71 hours are noted as being taken from what used to be spare time. Some 15 hours per month of farm work, presumably, has moved into computing, showing that it is increasingly becoming part of the planned activities.

The continuing importance of financial recording, financial planning and budgeting, and word processing is clear from the data on the time spent on the main computing functions. In 1993 2.93, 2.72 and 1.58 hours/month were spent on these functions, but these have now increased to 3.45, 3.47 and 3.01 hours per month. Also of interest is the wider range of functions that are now possible, particularly banking and communication functions. Table 7 contains the details.

In comparison with the 1993 figures the time spent on almost all business computing use has increased - indicating possibly that the users believe they are obtaining benefits, though another explanation might be that each task is taking longer than it used to with the widening range of computer experience and skill. Again it is likely that both explanations apply to different user groups.

Table 7

Time spent on business computing functions

	Average Hours/Month All Users	
	1993	1998
Financial budgeting	2.72	3.47
Livestock recording	1.59	2.04
Enterprise budgeting	0.20	0.54
Paddock/production recording	0.20	0.62
Letter and report writing	1.58	3.01
Financial recording	2.93	3.45
Electronic banking & tax	-	0.79
Spreadsheet calculations	0.70	0.67
Feed budgeting	0.14	0.40
Communication (faxes, Email)	-	1.21
Internet access	-	1.83
Other	0.70	2.98

Internet and communication activities are becoming a significant activity, as is electronic banking. When asked to rank electronic banking and the electronic receipt of bank statements on a 5 (very easy) to 1 (very difficult) scale the average scores of 3.91 and 3.93 respectively were obtained. Few, therefore, find these procedures difficult; though large numbers are yet to use these facilities.

The majority of users believe the increased return from computer systems at least covers its costs. Table 8 contains the responses obtained in both the current and the 1993 surveys.

Table 8

Computer profitability

	1998 Responses	1993 Responses
	(Percentage in Each Category)	
Extremely valuable	43.23	65.2
Moderately valuable	38.40	
Benefits just cover costs	7.24	12.3
Not economic, but must use	11.13	22.5

In that 88.87% believe their costs are covered, there appears to be an increasing number believing in profitability of computer use. Furthermore, some farmers (17.4%) noted they had purchased a computer for non-business activity and progressed to business use through a realisation of the possibilities.

In both 1998 and 1993 the younger computer users seem to value the computer more as do managers of large properties and those with higher levels of education. There doesn't, however, appear to be any difference in their objectives.

There is a clear correlation between a belief in the value of computing and education levels. Whether this is causal is conjecture.

5. The Internet and its use

In previous surveys the Internet was probably of little consequence and few, if any, farmers used it. In 1998 the situation is quite different. Of the 637 computer-using respondents 178 people are connected to the Internet, 385 are not, and 75 did not respond to the question. Thus, at least 27.94% are connected, though the true figure could be slightly higher. It is very likely this percentage is growing rapidly. Of the 385 not connected, some plan to connect quite soon (40% in less than 2 years). Table 9 contains the nominated time spans.

Table 9

Time before expect to have an Internet connection

Years	Percentage of the 385 Responders
< 1	17.92
1 - 2	22.08
2 + 5	15.06
Don't know	38.44
Never	6.23

The 'never' category is surprisingly low and at least another 40% expect to connect over the next two years. It would be surprising if this level did actually connect within this time frame, though no doubt the intentions are there. The major reason (29.73%) for not being connected is given as 'do not have a modem' - perhaps as new computers are acquired this problem will be overcome as most will have built-in modems. Only 7.53% said their telephone line was of insufficient quality, but a further 17.18% said the toll call costs were too great. The remainder had a range of less important reasons.

An analysis of the characteristics of Internet users does not appear to indicate they are very different to other computer owners, other than that their highest education level appears to be greater. The average hours per month spent connected was 7.82, and the average cost per month was $23.97.

Table 10 contains data indicating the type and frequency of connections.

Table 10

Type and frequency of Internet use

Type	Percentage of Users		
	Never	Occasionally	Frequently
Email	9.4	34.1	58.8
News and Weather	42.9	38.2	5.3
Market Information	48.2	29.4	7.1
Technical Information	28.8	47.6	12.3
Economic Information	51.2	31.8	2.3
Agr. Legislation Updates	68.2	14.1	0.0
Research Results	55.3	22.9	4.7
Entertainment and Fun	25.3	46.5	19.4
Ordering Equipment and Supplies	61.8	19.4	2.3

E-mailing is clearly an important activity, with 'entertainment and fun' also being important, but 'acquiring technical information' is also a significant use. All other uses are 'occasional', but again 'technical information' features prominently. Clearly, interest in legislation changes through the Internet is low, as is the interest in obtaining research results. Knowledge of where and how to obtain this information may not be good. Users' knowledge of how to obtain information needs to be researched, as does the type of information they are seeking. These are crucial questions.

The intention information presented earlier clearly indicates that a majority of producers intend connecting. The information in Table 11 shows age does not seem to be a factor in value belief, but education does. This is a similar pattern to the computer ownership case.

Table 11

Perceived value of the Internet relative to farmer characteristics

Age (yrs) *	Column percentages	
	Rated valuable or better	Rated not valuable, or neutral/undecided/no opinion
< 30	6.41	0.0
30 to < 40	32.05	29.88
40 to < 50	38.46	42.53
50 +	23.08	27.59
Education – highest level attained: +		
> 2 yrs 3^0	43.84	22.62
≤ 2 yrs 3^0	13.70	14.29
> 4 yrs 2^0	8.22	20.24
≤ 4 yrs 2^0	34.24	42.85

* Differences are significant ($x^2 = 10.562$, p = 0.032)
+ Differences are nearly significant ($x^2 = 7.227$, p = 0.125)

Overall, while the Internet potential is enormous, there is a long way to go in making available relevant and appropriately presented material, in devising appropriate charging systems and in educating primary producers in its efficient use. Breakthroughs will take some time as the demand will not be great until good information is generally available, and it will not be economic to provide appropriate information until the demand is higher. However, small gains will constantly occur, particularly in the low 'cost of provision' areas, so information providers must be prepared to budget for initial losses.

6. The nature of managers

The acquisition and effective use of a computer as a management aid appears to be increasingly important – most current users clearly believe this. Furthermore, the outside world is increasingly using computers and electronic communication as cornerstones to their operations so eventually primary production will not be possible without suitable computer packages. Managers must learn to use a computer system. To aid this educational process it is important to understand the nature of farm managers, particularly with respect to computer use. This will assist the design of training programmes for adjusting attitudes and approaches. As a move in this direction a factor analysis was carried out on the data available. This tended to indicate farmers could be grouped into four categories. These have been labelled the 'Producer', 'Family Man', 'Enjoyer', and 'Studier'.

Various combinations of variables, factor numbers and rotations were explored. These all pointed to the existence of these four underlying factors or types. Other studies have concluded a similar number of factors can be isolated (see, for example, Perkin & Rehman (1994), Fairweather & Keating (1990)) – though these studies were not computer orientated.
Table 12 below gives the factor loadings and communalities of the variables used in the basic analysis. A varimax rotation was used, though an oblique rotation (oblimin) pointed to similar loadings. The data was standardised and the covariance matrix used. This analysis included all farmers, both computer owners and non-owners. When grading each of the objectives (on a 1 to 5 scale) the farmers were also given the opportunity to write in an 'other' objective. When this is included in the analysis the percentages of variance explained jumps to 63%. It seems they each have a unique objective which, due to their great variety, could not be summarised in the report. However, while this additional factor is a significant contributor to the variance explanation, it did not alter the factoring into the four basic types.

Table 12

Factor loadings explaining the nature of
the four farmer categories

Variable	Factor number				
	1	2	3	4	Communality
	('Producer')	('Family Man')	('Enjoyer')	('Studier')	
Objective 1 *	1.73	.03	.14	.07	.55
Objective 2	.84	.04	.08	.03	.72
Objective 3	.47	.19	.04	.01	.26
Objective 4	.14	.11	.64	-.06	.41
Objective 5	.07	.60	.08	-.02	.38
Objective 6	.12	.32	.25	-.04	.18
Education Level	-.05	-.07	.04	.51	.27
Age	-.03	-.23	.06	-.33	.17
Size of business (su) +	-.07	-.04	-.06	.14	.03
Variance explained (%)	19.78	7.58	6.77	5.34	$\Sigma = 39.47$

* Note - the objectives are (See Table 1)

1 To be the best farmer/producer
2 To be the most productive
3 To make as much money as possible
4 To enjoy farming
5 To provide an income to raise my family
6 To have a reasonable income and plenty of time to enjoy other interests.

+ The size of business was measured in number of sheep equivalents (units).

The factor loadings indicate the 'Producer' stresses production and, to a lesser extent, money. The 'Family Man' has no major loadings other than the family objective and, to a lesser extent, a leisure time aspect. The 'Studier' seems to be single-minded in that education is the primary variable, though the -.33 factor loading on the age variable indicates a tendency towards youth. The 'Enjoyer' similarly is single-minded in that the major factor loading relates to the enjoyment objective, though there is again a tendency towards leisure time – this is to be expected. It should also be noted factors that might be related to size of business are not important (communality .03). Age is also only a minor variable.

Of crucial significance is whether computer owners are inherently different in some way to non-owners. If this was the case education and promotion systems, and perhaps even software design, might well have to be different in some way. Given nearly half of the producers in New Zealand now have a computer it is an appropriate time to make this assessment.

To achieve this the survey respondents were divided into the two computer owning groups and the factor analysis repeated. Table 13 contains the results.

Table 13

Factor loadings for computer owners and non-owners

(See Table 12 for definitions)

Column A = owners' loadings; Column B = non-owners' loadings

Factor										
	1		**2**		**3**		**4**		**Communality**	
	A	B	A	B	A	B	A	B	A	B
Objective 1	.77	.70	-.01	.05	.09	.16	-.08	.04	.61	.52
Objective 2	.78	.89	.02	.02	.08	.08	-.01	0.0	.62	.81
Objective 3	.42	.52	.18	.22	.08	-.01	-.03	-.06	.22	.32
Objective 4	.17	.11	.06	.15	.64	.70	.12	.02	.46	.53
Objective 5	.06	.11	.59	.59	.08	.017	.08	.12	.36	.38
Objective 6	.08	.16	.33	.32	.31	.17	.01	.01	.21	.16
Education level	-.01	-.04	-.14	-.05	0.0	.05	-.48	.27	.25	.08
Age	-.01	-.09	-.14	-.19	.04	.09	.20	-.59	.06	.40
Size of business (su)	.13	.02	-.04	-.03	-.12	0.0	-.19	.02	.07	0.0
Variance explained	17.86	22.96	6.64	6.52	6.90	7.09	4.20	6.22	Σ35.6	Σ45.3

The first factor in both groups (the 'Producer') are remarkably similar as is the second factor (the 'Family Man') as well as the third (the 'Enjoyer'). The difference lies in the fourth factor – the 'Studier'. For the non-computer owners education is a less important observed variable, but age becomes significant. This confirms, of course, all the data relating computer ownership to education and age. In simple studies size of business is also important, but clearly in these factor analyses a slightly different picture emerges, no doubt due in part to the inclusion of managers' objectives.

It is interesting to speculate on what has given rise to the particular objectives held by each manager. How much of the variability is due to genetic differences and how much his due to the childhood nurturing environment? Are farmers that were raised in rural areas different from those with an urban background? Is intelligence and personality a factor? Further studies will be necessary to provide useful conclusions (for work on personality, heredity and the environment see Matthews & Deary (1998), for the relationships between psychological variables and objectives see McGregor et al (1996)).

It must be stressed, however, that other than age and education level differences, the computer owners and non-owners do not appear to have different objectives. Whether their inherent abilities are different is not known. The tentative conclusion must be that there is no intrinsic reason why computer uptake levels will not continue at current levels. In this process educational and support programmes will be important and need to be designed with the nature of the current non-owners in mind.

The computer owners were further divided into various sub-groups and factorised to see if further differences might emerge. However, only minor differences appeared. For example, managers who used their computer more than ten hours per month relative to the others tended to load more onto the money objective for the 'Producer', and the 'Enjoyer' tended to have greater stress on the enjoyment objectives. In addition a further variable 'years of ownership' was introduced and was related to greater hours of use, as was size of business. For farms where the spouse carried out more than 50% of the computing the education, age and years of ownership variables featured in explaining a significant proportion of the variance. When all farmers that did not believe a computer was economic were excluded the money objective variable became more prominent in the 'Producer' factor. Maybe people with a major interest in cash returns put stress on making the computer work for them.

Finally, when all variables other than the objectives were excluded from the factor analysis the percentage of variance explained increased to 50.69%. The important factor loadings varied slightly as education was no longer a consideration, but the 'Producer', 'Family Man' and the 'Enjoyer' were clear factors. The fourth factor had the money objective as an important variable. It might be speculated that some families stress education as an important aspect to life and this becomes imprinted as an objective influencing later life. Clearly, these aspects need more detailed data collection specifically designed for this purpose.

7. Conclusions

It is very evident that computing activity is becoming a significant and important part of management. The number owning small computers has declined quite markedly in favour of standard MSDOS/WINDOWS type machines. In addition, the time spent on financial computing (accounting, cash flows, budgeting...) has increased compared to 1993 even though the total computer time per month is less. Perhaps computing time is spent more effectively, and, possibly, less time is spent on entertainment and learning. It should also be stressed that computing tends to take place regularly rather than on 'rainy days' and/or in spare time compared to the 1993 situation.

The rate of computer system uptake in New Zealand continues at rates similar to recent years, and it appears this will continue for some number of years. Over the last five years, on average, 3.66% per year of the population became involved in computing. With 42.72% of primary producers owning a computer, this rate may well be greater than anticipated over the next few years as the business community around them increasingly relies on computers for day to day operations.

The correlation between computer ownership, higher levels of education, and large farm size shown in 1993 continues in 1998. These relationships must eventually decline except perhaps for the education situation as new industry entrants may have a generally higher and rising level of education.

This 1998 survey asked farmers to indicate their involvement in off-farm business. This data showed computer owners tend to have other activities and consequently possibly gain greater value from their computers. The farmers with off-farm businesses left the formal education system at a higher level than the others.

It is clear that the functions, other than the use of the Internet and electronic banking, have not changed much. Thus, having learnt financial management packages it appears producers are not keen to explore new packages such as, for example, feed management systems. Perhaps the packages available are not adequate, or possibly the perceived benefits do not outweigh the expected time commitment and cost. Effort must be directed to finding out what is in fact the case, thus enabling developers to correct the problem. It is doubtful whether benefit can only be obtained from financial systems.

An analysis of objectives and other personal factors suggests computer owners are not inherently different from non-owners. While their age, education and business size tend to be different, it seems their motivations are not. This means computer education and support systems will become increasingly important to enable the less confident to move into computing.

While not of direct relevance to the changing computer scene, a striking factor is evident from the age information - the average age of farmers in 1998 relative to 1993 is higher. This clearly raises questions of whether this is due to decreasing retirement expectation income (and possibly lower land values), or whether there is simply a decline in the numbers of young people interested in farming. This demands further investigation. It is also interesting to note that farm size does not appear to be increasing despite the declining terms of trade - are farmers accepting lower income, or is off-farm activity increasing?

It would have been interesting to obtain data on farm labour as perhaps less is employed in response to the economic situation (NZ Meat & Wool Board data indicates in 1985/86 there were 1.67 labour units/farm, and in 1995/96 this was 1.59). When it comes to computing there is a clear indication that the 'spouse' is heavily involved, and also other family members at times. Perhaps the same applies to other farm activities.

A new factor in computing is clearly the Internet. The data suggests over a quarter of computer owners have a connection, and this proportion is expected to increase quite rapidly. Currently email is the main use, but this may be a function of the services available not meeting farmers' requirements.

Compared with 1993, more farmers believe their computing activity increases income more than costs despite the fact that a wide range of farmers are now involved. While comparative figures are not available it also appears the Internet users believe this activity is profitable. It is very likely their view of value will continually improve as more services are made available.

Finally, it is important to note that education is a factor in many of the relationships explored. Computer owners tend to have greater formal education than non-owners, Internet users similarly relative to those not connected, and farmers with non-farm businesses also tend to have higher education levels. While there is no definitive proof that education conveys greater economic returns, it certainly seems to relate to innovation and entrepreneurship as well as a belief that the innovations have conferred greater value.

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