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THE IMPACT OF MICROCOMPUTERS IN AGRICULTURE
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INTRODUCTION

Approximately one-half million farmers will buy microcomputers in the next five years according to farm computer expert Bob Harris, of Harris Technical Services of Lincoln, Nebraska. (1)

Farmplan Computer Systems makes the following statement. "Remember hearing about how the first tractors were introduced to American agriculture? At first acceptance was limited, but before long, those in the business of farming realized that an investment in a tractor would yield high returns by saving time and energy... Many people, including the staff at Farmplan, feel that computer technology in agriculture will follow the same pattern. At first only the most innovative, aggressive agribusinessmen will see the value of this management tool. Many have already puchased good systems and use them regularly. But before long, a microcomputer will be as important to a farm business as the tractor." (2)

It would appear that the microcomputer is the answer to many farmer's data management problems. But with any rapid influx of highly technical equipment there are bound to be some difficulties. Herein lie two major challenges of computerizing the farm.

1) A need for adequate preparation by the farmer to understand the fundamental principles of computer technology.
2) A need for adequate support personnel to help in software development, hardware maintainence, etc.

It will be the attempt of this paper to examine three areas involving the microcomputer for farm use.

1) The capabilities and uses that currently exist for the microcomputer in agricultural applications.

2) The challenges that computer technology present, specifically in this case to agribusinessmen.

3) The need for support personnel who have knowledge and expertise in both agriculture and computer science.

CAPABILITIES, USES AND POSSIBILITIES FOR THE MICRO

Computer technology has been well established for many years in most phases of industry, including agriculture. But this has only been available on mainframe or large computer systems based at central locations. The advent of the micro-chip and the integrated circuit opened up a whole new world of computer design which has evolved into the development of the microcomputer. As a small, compact and relatively inexpensive computer it is gaining wide popularity because of its versatility and portability. Now, instead of purchasing an account on a large computer system farmers can buy their own computers. Even farmers who have never used mainframe computer systems are inclined to purchase a micro.

For those who have never worked with computers and don't realize what they can accomplish, a look at some of the current programs (software) available to farmers will open their eyes.

Cattle Feeding Economics	Cow-Calf Profitability
Crop Yields	Fertilizer Formulation
Soil Erosion	Economics of Corn Production
Sprayer Calibration	Machinery Cost Estimation
Investment Analysis	Financial Planning
Farm Records	Cash Flow
Income Tax Management	Payroll

It is obvious that it does not require a microcomputer to accomplish these tasks since farmers have been doing them for years. The micro's

strong points are that it will do these "paper and pencil problems" in a fraction of the time that it takes by hand and in most cases with greater accuracy. In addition, the algorithm and the accompanying results can be stored in memory, disk or cassette and recalled almost instantaneously. The micro is also used to tap into larger computer networks, thus, making a wide selection of programs, listings, etc., available to the farmer. Therefore, the main areas of computer use are:

A. Data storage and retrieval as for record keeping, etc.

B. Decision-making tool.

C. As a terminal to down load information, data or computer programs from a larger computer network. (3)

Data storage and retrieval. Data storage and retrieval on a computer is essentially no different than the conventional method of using file cabinets. What is different is the time involved. An operator who has vast amounts of data to manage is all too often burdened with the actual mechanics of sorting and filing. This often leads to frustration when after filing a paper it takes 20 minutes to find it again. This can be avoided by storing data on disks with the aid of a microcomputer and a disk drive. The amount of storage capacity on the 5 1/4" piece of flexible mylar disk ranges from 160 to 1000 K or approximately, 100-600 typewritten pages. At $5.00 per disk, it represents relatively inexpensive storage. The concept of data storage on disk is no different than storing music on a cassette tape. The disk is coated with magnetic particles which store the coded data magnetically. Accessing the stored data on disk simply requires inserting the disk in the disk drive, typing in the code name of a particular data file and the disk drive head quickly locates it as the disk spins around. To access a large file or program may take 5-10 seconds on a

floppy disk system, while accessing data on a hard disk is nearly instantaneous. Either way, it beats searching through filing cabinets.

A good example of record keeping using the microcomputer is in a dairy operation. At least one milking machine manufacturer sells a system using a microcomputer which records the milk weight of individual animals at each milking and prints out herd analysis factors after the herd is milked. (4) Countless other examples could be cited of different record keeping functions that microcomputers aid in performing.

It is important to remember that good record keeping will still take large amounts of time even with a computer, and that it won't turn a poor manager into a great one. A microcomputer will simply enhance an existing data management system and allow for quicker, better decisions.

Decision-making tool. The real power of the microcomputer emerges in decision-making applications. Many of the programs listed previously are geared at helping formulate decisions based on the user's unique input data. Decision-making programs are set up in such a way that data is entered when called for, parameters are set and then the algorithm is performed. The resulting answers or prospective decisions are then displayed on the screen and/or printed.

Decisions on the farm today are not as easy as they were many years ago. Because of the complexity of today's economic society and the rapidly expanding frontier of agricultural technology, the agribusinessman is faced with decisions that draw upon many different disciplines including economics, mathematics, accounting, soil science, plant science and engineering. Today's farmer, or anyone else for that matter, is hard pressed to be well versed and up-to-date in all of these disciplines. Farmers are the last hold-outs. Farmers have historically been the "jack-

of-all-trades", and they prefer to act for themselves rather than hire a specialist. However, a recent survey conducted by Successful Farming among a group of young farmers, between 25-35 years of age found that 81% would depend more on specialized advisors and/or consultants on various aspects of farming and 87% said they would utilize some sort of computer system to help in farm record keeping, decision-making, etc. (5) The "younger generation" farmers are realizing that they simply do not have the time or expertise needed for all the decisions they face. The use of specially prepared computer programs, written by experts, can allow farmers to generate the information, based on their own data, in a fraction of the time it would take to do it themselves. Furthermore, these programs are written by specialists, be it in agricultural economics, dairy science, soil science, etc., who have information that is usually more accurate than the farmer. Therefore, the farmer can make better decisions in their farm management which, hopefully, will lead to increased profits.

As a terminal to access large computer networks. An agribusinessman who wants current market reports, weather information, special bulletins, a wide variety of ag. related computer programs and a place to list cattle or produce for sale, can use a microcomputer to access these data or programs. With a "modem" or phone hook-up a microcomputer can act as a terminal into a large or mainframe computer system. Such systems currently existing are AGNET in Nebraska, "Green Thumb" in Kentucky and TelPlan in Michigan.

AGNET, which stands for Agricultural Computer Network, began at the University of Nebraska in 1975. Its growth was rapid as ranchers and farmers began to utilize its services. Today it delivers customized ag. information to over 30 states and at least 3 foreign countries. (6) By using a microcomputer as an interactive terminal to a system such as AGNET,

farmers can access programs that are not currently available for microcomputers or run programs that are too costly to purchase, but which provide valuable data. The costs include the computer time used and the phone charge (usually long-distance). AGNET officials say that most users spend about $10.00 per hour of computer use (plus phone). (7) But this generally represents a fairly reasonable charge when what is offered is considered. AGNET currently has well over 200 specific ag. programs on line, each of which has been developed by teams of ag. specialists.

THE CHALLENGES PRESENTED BY COMPUTER TECHNOLOGY ON THE FARM

The main area of concern with the use of computers in agriculture concerns the proper training and preparation of the agribusinessman before and after the purchase of a computer. The purchasing of a computer system involves preparation to make the new tool worthwhile. It would be foolish to purchase a tractor simply by its appearance, and the purchase of a computer is no different. Many look very impressive on the outside, but it is the circuitry inside and the software (programs) available that really make it an effective tool.

Most farmers have had no background or experience in working with computers. As a result, they commonly feel inadequate and perhaps even intimidated by them. The best way to overcome those feelings is to learn about them.

First off, a little reading can go a long way. Recently, many good publications and periodicals have been written that have focused of the use of the farmbound microcomputer. Seminars and workshops are also available and will become increasingly widespread in the coming years. For those who

live near colleges and universities, classes are offered that deal specifically with the microcomputer.

A communication barrier can often exist between computer dealers and farmers. This is caused by a dialect called "computerese". The problem is sometimes enhanced when the farmer speaks too much "farmese." Suffice it to say, many dealers use words that are unfamiliar to most people, including farmers, and many farmers don't know enough about computers to properly explain their needs to computer specialists. Understanding how the computer actually works is not necessary, but knowing enough to properly explain your needs to the dealer is. Preparation would enable the farmer to understand the computer dialect which includes words like floppy disk, CRT, byte, modem, Basic, K, random access memory, peripheral, Cobol, disk drive and others. (see last page for a brief dictionary of computer terminology.)

Another major problem is software selection, or in other words, what kind of programs have been written that will fit a particular farmer's needs and special circumstances? Software, or the actual computer programs written by someone are as crucial to using a computer as a steering wheel is to a tractor. Because of unfamiliarity with computer technology many farmers, and for that matter non-farmers, do not realize how vital the software is. This realization commonly comes too late. A microcomputer has been purchased and it is soon discovered that unique computer programs which are not compatible with the computer system that was purchased must be acquired. The computer is of no value to them until they can run programs which meet their data management needs. Many good programs have been written by specialists but farmers sometimes have a difficult time adapting them to the unique circumstances and management style of their

particular farm. For example, Craig Coberly, of Gove, Kansas recently faced this particular problem. As a feedlot operator he recognized the need for a computer to help manage his operation. After purchasing a micro he was faced with the problem of obtaining the necessary software. After analyzing the options he chose to write his own programs for the following reasons. First, he believed that the available commercially written programs did not suit his unique style of management and data needs. Secondly, finding a consultant to write his programs who had a reasonable blend of knowledge in farming, feeding cattle, and computer technology was a difficult task. Furthermore, he believed that the communication problems were going to be horrendous between himself and a consultant. Craig's situation might be the exception rather than the rule, because he had some prior computer experience. Craig's decision to write his own programs was based on his expertise and needs as he expressed in the following way. "It has allowed for development of programs to my specific needs and has allowed for a larger range of applications. I do not mean to imply that all farmers should write their own software... When choosing between the three options, a user has to analyze his informational needs, skills, priorities and objectives." (8)

Most farmers will choose to purchase software rather than write it themselves, and for this reason it is vital that they realize the importance of choosing software first, and then selecting the hardware, or the actual computer, which will be compatible with the software needed. One final word about computer software needs to be emphasized--let the buyer beware! All to often a computer "print-out" is viewed as sacred and unerring in spite of the true axiom, garbage-in-garbage-out. Unfortunately, there are computer programs written that are poorly

documented, awkwardly set-up and even just plain wrong. Hence, it is strongly advisable to carefully select software from reputable sources. The rule of thumb to live by is: you get what you pay for.

Farm Computer News, a monthly newsletter published by Successful Farming, lists new programs on the market and rates them based on accuracy, documentation, price and other factors. This, along with other critiques, can be a helpful screening process for farmers in search of good software. Several guidelines are suggested when purchasing or developing software: (9)

1) Don't computerize tasks you can do better or faster by other means.
2) Don't computerize unless it's something you do routinely and frequently.
3) Don't computerize unless the gained convenience enables you to do the job more often.
4) Don't computerize if accuracy or detail isn't critical.

After scrutinizing and selecting the appropriate software, the farmer can now direct his attention to purchasing a computer system that will be compatible with the purchased software. Printer quality, screen width, memory capacity and price are among some of the specifications to be considered. If properly prepared, purchasing the appropriate hardware will be fairly easy. But for the farmer who has not done his homework it can be a maze of confusion. Of the many microcomputers currently on the market, the APPLE II and Radio Shack's TRS-80 are two of the most popular among farmers. (10) Several reasons contribute to their popularity. First, they each have a wide network of dealers to help in hardware maintainence and new software distribution. Second, they are priced affordably. Third,

there are many programs available that are compatible with both of them. Fourth, they have add-on ability to increase memory capacity, screen width, etc. Most farmers buy micro's with 32-48K of main memory, a 40 column wide screen, 1 or 2 disk drives and an 80 column printer. All of this plus the the necessary software disks, can represent an investment of $4000 or more. In considering this amount of money farmers should analyze their needs before purchasing a microcomputer. It might be found that they really do not have enough data to manage to warrant purchasing a computer. A hand held programmable calculator or paying someone else for the use of their computer may be a wise second choice.

One final note on purchasing hardware needs to be mentioned--find a dependable and stable dealer. Every farmer knows the value of a good relationship with the local implement dealer, especially during harvest season when breakdowns occur at inopportune times. A farmer's relationship with the computer dealer is no less important for the same reasons. A dealer who will provide assistance and support is an asset, especially one who knows something about farming. Steve Beetz of LaSalle County, Illinios, feels that, "A good dealer is worth a 10% to 20% high initial (computer) price." (11)

SUPPORT PERSONNEL WITH AG. & COMPUTER BACKGROUNDS

It would be untrue to assume that people who have both a good agriculture background and a knowledge of computer science don't exist. There just are not enough of them. Most ag. consultants do not pretend to be computer specialists, nor do computer programmers claim to understand farm management problems. Most computer dealers cannot tell wheat from barley. As a result, who is left to help the computerized farmer?

One group that has taken an active role in providing educational assistance and quality ag. software is the Agricultural Extension Service at the land-grant universities around the country. Utah State University, for example, purchased 5 APPLE II computers in 1980 for use in the extension offices throughout the state. Since that time a total of 45 APPLE computers have been purchased by U.S.U. and nearly every extension office in Utah has one. Using the APPLE as an intelligent, or interactive terminal, a farmer in Moab can access programs on the mainframe computer in Logan. According to Larry Bond, Extension Economist at U.S.U., the APPLE "...has been demonstrated to thousands of people in Utah during the past year. As of July, 1981, programs have been run at no cost to our clients. At some point in time our educational effort will be over and we will start charging for this service..." (12) Utah's extension experience in microcomputers is not alone. California, Florida, Michigan, Nebraska and others have responded to the needs of this technological boom in farm data management by holding workshops and seminars to help train farmers about computers and their agricultural applications.

Perhaps it is speculative but certainly within the realm of feasibility to project a greater need for ag. consultants with a healthy computer background. In my own mind, I have to believe that as farmers become more and more specialized they will call upon specialists, be it extension agents or private consultants, to help with their decision making and financial problems. Big business has used specialists for many years and farming is heading in that direction. Agriculture, while it still can be a way of life, is being forced to adopt a more business-like profile. Individual farmers are becoming more professional and approaching their work more analytically. While the home-based computer will be a great

asset in farm data management and decision-making, specialists who excell in a particular facet of agribusiness management will always be in demand.

One more group that has already had an impact on the use of computers in agriculture are commercial firms dealing specifically with ag. related software packages. FarmPlan Computer Systems, Pioneer Data Systems, Powersoft Inc., AAA Ag. Services and Farm System Inc. are just a few of the many firms that are springing up all around the country. They are providing many good software packages that can help solve the complex problems faced by today's farmer. Undoubtedly, they will continue to be a major, if not the primary, source of support personnel for the computerized agribusinessman.

SUMMARY

Computers on the farm will become as common as the tractor. Despite the difficulties that accompany advanced technology they will be a great tool in the hands of the farmer to increase overall efficiency. Perhaps a look to the future would appropriately conclude this brief treatise. "Computers will be used to turn implements into robots. Program the computer on your tractor and you can sit under the oak tree while it plows the field, plants the corn, and so forth. And the dozen steps it takes now to prepare the ground, plant the seeds, apply the herbicides and pesticides and irrigate, will all be done in one step." (13)

Sound impossible? So did pulling an eight bottom plow.

Basic: popular computer language developed at Dartmouth College for educational purposes. Stands for Beginners All-Purpose Symbolic Instruction Code; is now available on many microcomputer systems.

Bit: the contraction of BInary DigiT. A bit always has the value of "0" or "1." Bits are used in electronic systems to encode information, instructions and data. Bits are usually grouped in nybbles (4), bytes (8) or words (up to 32).

Byte: a set of 8 bits (usually). A byte is used to represent a character. Microcomputers can handle one, two or four bytes at a time, depending on the way they are designed.

Character: any letter, number or symbol that can be transmitted as output by the computer.

Chip: thin, flat slice of silicon measuring up to a few tenths of an inch square, containing an integrated circuit on its surface.

Cobol: COmmon Business-Oriented Language. A high-level computer language that uses commands that resemble English. Cobol was designed specifically for business use.

Computer: a general-purpose electrical system designed for the manipulation of information (data), which incorporates a central processing unit (CPU), memory, input/output facilities and power supply.

CPU: Central Processing Unit. The computer module in charge of fetching, decoding and executing instructions.

CRT: Cathode Ray Tube. The television-type tube used to display pictures or characters.

Diskette (Floppy disk): a flexible disk that rotates inside a special jacket which protects and cleans the surface. Cut out holes provide access for the moving head (which must be applied against the disk in order to read or write) and for index information.

Documentation: the written support material for a computer or a program (user or operator instructions).

Fortran: FORmula TRANslator. Early high-level language devised for numerical computations—often used in science applications.

Graphic display: bar graphs, charts or drawings.

Hard copy: computer output on paper.

Hard disk: a type of secondary memory. It is a flat, circular object that resembles a phonograph record. A record "stores" or records music; a disk stores information.

Hardware: the bolts, nuts, boards, chips, wires, transformers, circuits, etc., in a computer—the physically existing components of a system.

Input: any information coming into the computer.

Interface: the hardware or software required to interconnect one portion of the computer to another.

Keyboard: a group of pushbuttons used for entering information into a computer system.

K: means "1000." Actually, in computer it stands for 1024, and is used as a measurement of memory capacity.

Language: in relation to computers, any unified, related set of commands or instructions that a computer can accept.

Main memory: the internal memory of the computer contained in its circuitry, as opposed to peripheral (or secondary) memory (tapes, disks).

Menu: a list of what is available by making a selection. For example, a home computer might display the following menu: "Do you want to: 1. Balance checkbook? 2. See appointments for March? 3. See a recipe? Type number desired."

Modem: MOdulator-DEModulator. A device that transforms a computer's electrical pulses into audible tones for the transmission over a telephone line to another computer or terminal and vice versa.

Output: any information coming out of a computer, via any medium—printer, CRT, etc.

Peripheral: any interface device connected to a computer.

Program: a sequence of instructions.

RAM: Random Access Memory. A memory that contains information that can be erased or modified.

ROM: Read Only Memory. A memory that contains permanent data that can't be altered or erased, such as a Basic interpreter.

Secondary memory: slow in access time compared with main memory, but generally much greater in size. Sometimes called mass memory. For example, disks and tapes.

Software: any set of data or coded instructions that cause the computer to perform a task.

Word: the largest number of bits, usually 8 or 16 for microcomputers, that the processor handles in one operation.

Word processor: a text editor system for writing, editing, formatting and storing letters and reports prior to printing.

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