Technology transfer - perceptions of extension agronomists

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Abstract

Over the past 100 years, astounding changes related to electronic communication have occurred. With the advent of electricity, the telegraph transformed communication, followed by the telephone and facsimile. Then, development of computer communication capabilities on mainframe systems were followed by personal computers and the tremendous popularity of e-mail. Recent development of multimedia information system capabilities for the WWW have once again transformed electronic communication. Our challenge as scientists, educators, farmers or ranchers, and agribusiness men or women is to make effective use of the available technologies. Much has been done to integrate electronic communication into our offices, laboratories, classrooms, homes, farms and business. Much remains, however, to fully utilize current capabilities and to extend those capabilities to meet our needs. Change inevitably occurs. However, in agricultural production systems change is sometimes rapid and at times quite slow. A positive combination of economic benefit, social acceptance, and practical application leads to rapid adoption of new technologies. If any one factor is lacking, adoption is much slower. Surveys of extension agronomists suggest a balance of traditional and emerging technology transfer techniques should be used to address the economic, social and practical aspects of change.

Key words

Computer, e-mail, Internet, World Wide Web, clover, grazing.

It is indeed a pleasure for me to visit your beautiful country and an honor to participate in this prestigious and important meeting of the Australian Agronomy Society. I compliment the program committee for insights and creativity in selecting? "Agronomy -Growing a Greener Future" as your theme while addressing three critically important imperatives. I cannot think of three more important and timely imperatives than our environment, the people and quality assurance.

I bring you greetings and best wishes on behalf of the American Society of Agronomy, Crop Science Society of America, Soil Science Society of America, Certified Alfalfa Seed Council, the American Forage and Grassland Council, Society of Range Management and Oregon Clover Commission along with our respective states and universities. We extend an invitation to you to join us in any of our meetings, events or activities.

The title of this paper, "Technology Transfer - Perceptions of Extension Agronomists" came about as a result of a meeting in Canada during the Spring of 1997.? I was asked by the program committee of the XVIII International Grassland Council to chair a Technology Transfer Theme. I presented a paper in that session entitled "An Extension Agronomists Perceptions Regarding Clover Use in the USA". In addition, Dr. Don Ball, Extension Forage Crop Agronomist at Auburn University, and I put together an International Clover Workers banquet and program. I spoke on the "Role and Importance of Clovers ". A number of Australian colleagues attended one or both of these events, and subsequently Professor Ted Wolfe and Professor Jim Pratley asked about my interest and availability to speak at this Conference. I share with you today what my response to them was, "I would be honored to travel to the beautiful country of Australia and be able to associate with some of the world's leading research, extension, teaching, agribusiness and governmental personnel along with some of the best farmers in the world." Professor Jim Pratley's first e-mail message to me confirmed my topic as "Technology Transfer -Role of Clovers in USA Pastures and Perceptions of Extension Agronomists Regarding Clover Use". As time passed, the

title was shortened to "Technology Transfer - Perceptions of Extension Agronomists". The following represents a collection of ideas, information and results from work the authors have been involved with regarding technology transfer and perceptions concerning two major forage emphasis areas:

- use of clovers; and,
- imitations to adoption of intensive grazing.

Technology transfer

CHANGE is the one constant of life. Over the past twenty-five years I have heard many keynote speakers at various meetings talk about change. I know of no area of human affairs or any time in our history when "change" was as great as it is now in the area of technology transfer. In order for me to more fully understand and appreciate the present, I need only visit my past. I grew up on a crop-livestock farm in the western Kentucky coal field area. We farmed with horses and mules, had no electricity, running water, indoor plumbing, telephone or newspaper. I joined the Army at seventeen and was stationed in Germany for three years. During that three year period, I communicated with family in the USA only by "snail" mail.

Computers touch many aspects of our lives today. As scientists, we use computer software to design our experiments, analyze our data, prepare reports and develop slide presentations. Mailing lists are on database programs, and budgets are developed and managed on spreadsheets. We communicate with our colleagues worldwide via e-mail lists that contain hundreds of people or individually by using specific addresses. Application software is available for specialised needs including gene mapping, breeding histories, cultivar characteristics, fertility and chemical recommendations, pest management, ration balancing and enterprise accounting. Research measurements can be automated with microprocessor equipped devices and global positioning systems can provide precise identification of location for application of fertilisers, pesticides, and other uses.

Agribusiness has rapidly adopted computer technologies with uses ranging from inventory management and record keeping to marketing. Farmers use computers to monitor weather and markets, balance rations, keep records, budget farm enterprises, and to acquire rapid technical information and support. Computers allow more rapid communication and quicker decisions regarding problems and projects. The number of farmers using computers is increasing daily. According to 1997 data, thirteen percent of USA farms had Internet access (12). Internet access ranged from 4% in Louisiana and Mississippi to 31% in New Jersey. Thirty-one percent of USA farms own or lease computers, and 20% use computers for their farm business. Undoubtedly, percentages are far greater today.

With all of the wonderful tools available, what else is needed? What contributions could be made by electronic technologies to improve the work we do and the services we provide? Perhaps the next step is to apply present technologies to collaborative work. A workload-sharing mind-set is needed. Electronic technologies are available to facilitate this change. A collectively developed and professionally reviewed forage electronic information system available 24 hours-a-day without disturbance to anyone is now reality. It is called the Forage Information System WWW (http://www.forages.css. orst.edu) (6).

My first presentation at the American Society of Agronomy meetings required several weeks of preparation and much patience in working with our graphics department to end up with then-state-of-the-art blue diazo slides. To say things have changed would be an understatement. The slides for this presentation can be made with multi-color graphics, and imported digital images in less than two hours. Yes, a lot of things have changed. Computers are everywhere; e-mail, mailing lists, and discussion groups are giving way to Web Sites; and Home Pages are proliferating at an amazing rate.? Since 1969, the number of network servers has grown from 4 to 13 million (5). Where would we be without word processors, spreadsheets, e-mail, faxes, cellular phones, digital cameras, satellite uplinks and downlinks, internet connections, and the WWW?

These technology driven advances, as amazing as they are, certainly come with a downside. Expense alone has kept many from taking advantage of emerging technologies. Using limited funds to purchase computer hardware only to learn it is outdated when it arrives is a frustrating experience. The lack of technical assistance for installation, repairs and maintenance, has been a common problem. To take

advantage of emerging technologies also requires considerable investment of time.? This includes time to be trained as well as to train staff and workers. Because we can communicate quickly, easily, and cheaply, there is a lot of unnecessary communication, especially on the Internet. We must recognise that more communication is not always better communication. Incorrect information transferred rapidly is far inferior to correct information transmitted slowly. Credentials are not required for making information available on the Internet. Realisation of the potential of these technologies will require that both social and economic issues be addressed in a positive, practical and punctual manner.

Extension agronomist perceptions

Extension Agronomists use a variety of tools and technologies to facilitate transfer of information and share knowledge and experience. These include techniques and technologies that have proven to be effective in the past as well as emerging technologies. The better the educational needs of extension clientele are understood, the more likely it will be that the educator will be able to select the best combination of technology transfer tools to use.

An old Chinese proverb states, "A problem well defined is half solved already." Accordingly, correctly assessing attitudes and educational needs facilitates making good decisions regarding approaches of technology transfer. The results from two surveys recently conducted in the United States relating to the issues of clover use and grazing management are examples of the type of information and insights which can facilitate effective Extension programs, including (but not limited to) determination of the appropriate mix of technology transfer tools.

Clover Use

Forage legumes offer numerous benefits in forage/livestock systems, including biological nitrogen fixation, high forage quality, good forage yields, improved distribution of growth as compared to growing forage grasses alone, offsetting of certain livestock disorders, and improved soil tilth (1, 2, 7, 8, 9, 10, 11). Despite these attributes, legume usage by forage/livestock producers in the USA has been less than some clover enthusiasts feel is appropriate. Reasons given include: fear of bloat, lack of knowledge concerning benefits, greater management requirements and poor persistence. However, there are indications that the use of forage legumes, including clovers, is becoming more feasible and justifiable.

Clovers (*Trifolium* spp.) are a diverse genus of leguminous plants, at least 15 species of which are used to an important extent for forage production in the USA (11). Due to the collective wide adaptation and multiple use of clovers, and changing economic conditions which encourage striving for lower inputs and higher animal performance, it seems logical that clover acreage will increase during the next several years. The use of clover in forage programs has dual benefits. When clovers are present, animal performance increases while expenses decrease. Clovers are truly sustainable plants. Research results, farmer experience and many demonstrations have clearly shown clovers to be agronomically sound, environmentally friendly and economically advantageous.

Extension Forage Crop Agronomists throughout the USA work closely with forage/livestock producers in various geographic areas. Therefore, learning the attitudes of Extension Forage Crop Agronomists can provide important insights regarding the problems (perceived or real) and opportunities related to using clovers, as well as help identify additional research and/or educational needs.

In an effort to determine Extension Forage Crop Agronomists attitudes and perceptions regarding clover use, a survey was prepared and distributed throughout the USA (10). The survey was sent to 104 state and area agronomists in 43 states with a 68% return.

As expected, there was a wide range of responses to each statement. In many cases this was related to geographical differences in adaptation of various clover species and/or the types of forage systems typically used by producers. The mean responses nonetheless provide much insight regarding the

attitudes of extension agronomists (and presumably the producers with whom they work) relative to various aspects of clover usage.

Statements regarding clovers for which respondents provided rankings can be placed into three categories: (i) problems or concerns; (ii) benefits or opportunities; and (iii) general attitudes regarding clover usage. Mean rankings provided an indication of the importance of various items relative to each other. However, for discussion purposes in this paper, we have grouped responses into four categories: highly important, import- ant, relatively unimportant, and highly unimportant.

No problem or concern fell into the "highly important" category, but lack of producer realisation of clover benefits and perception of poor persistence were ranked as important. Bloat, the cost of clover seed, grass competition, soil acidity, the perception that clovers require too much management, and low soil phosphorus or potassium levels were considered relatively unimportant factors overall, but some individuals did rank some of these as being important in their area.

Potential opportunities or benefits associated with growing clovers ranked much higher. The ability of clovers to improve forage quality was ranked as highly important. The possibility of better grazing management for increasing clover populations, better distribution of pasture growth, biological nitrogen fixation, increased forage yield, and the potential for offsetting animal disorders were ranked as important factors.

With regard to general attitudes regarding clovers, there was a highly important ranking overall regarding whether the participants considered themselves to be advocates of the use of legumes. Furthermore, the concepts that clover usage is becoming more feasible and that more profitable operators use clovers were both ranked as important.

Farm demonstrations were ranked overall as being a highly important educational technique, while magazine articles and educational meetings were ranked as important. Publications, news releases, and videotapes or slide/tape sets were ranked as relatively unimportant.? Questions relating to computer use and Internet access will be included on future surveys.

Limitations to adoption of improved grazing manage- ment

Since the establishment of the USDA Cooperative Extension Service in 1914, public agency advisors have been encouraging livestock producers to adopt improved grazing management practices. In recent years? "Sustainable Agriculture " has become the banner for advocates of ecologically sound grazing land practices.? Numerous grazing research and education projects have been funded with Sustainable Agriculture Research and Education grants at the national, regional, state, and local levels. While many producers have adopted recommended practices, millions of hectares of grazing lands in the USA and worldwide are still either producing below their biological potential or are deteriorating due to mismanagement. We might ask, "Why, with the plethora of research findings and documentation of the benefits of improved grazing management, do producers fail to adopt these practices?" As researchers and teachers who are involved with pasture and grazing, it is easy to believe that if producers would just adopt our recommendations, their farms would be more profitable and their lives more comfortable. It is frustrating when they do not. Do producers doubt the validity of our research? Frequently they do, but more often the answers are to be found in economic and social considerations rather than in the biological or physical sciences (3).

Economic comparisons based on small scale research trials can be very misleading. Gerrish *et al*. (4) reported that near contradictory economic conclusions could be drawn from the same physical data in a grazing trial depending upon the scale of interpretation used for the research results. Component studies that fail to account for expenses or income occurring prior to or subsequent to the actual research period often lead to erroneous economic conclusions. Livestock producers frequently detect the shortcomings of this type of research and are skeptical of the conclusions. Hence, they may consider recommendations associated with the research findings to be suspect. Producers are more likely to accept case study records of actual farming operations as an indication of whether or not a particular management strategy

may increase their net return. This is also why producer testimonials can be particularly convincing and effective, as our friends in industry are well aware.

Extension advisors who have attempted to persuade producers to adopt some new technology have at one time or another invariably heard the statement, "But this is how we have always done it!". Perhaps that simple statement reveals the single greatest obstacle to improving grazing land management worldwide. There are several reasons why it may be easier to maintain the status quo than adopt new technologies. Lack of understanding and fear of change are the two greatest social obstacles to adoption of new technologies.

Lack of understanding may result from both the supply of misinformation as well as the lack of accurate information. The relatively small extent to which alfalfa is used as a grazing crop in the USA is a good example of how lack of understanding can limit the use of a crop.? The two largest producers of alfalfa worldwide are the USA and Argentina, accounting for over 50% of alfalfa production worldwide. With over 10 million ha of alfalfa, only about 2.5 million ha are grazed in the USA.? Contrast that to Argentina where 7 million out of 8 million ha are grazed. The primary difference is that Argentine ranchers understand the benefits which can be realized from grazing alfalfa while farmers and ranchers in the USA lack that basic understanding (3).

Fear of change, whether fear of lost income or loss of respect by one's peers, is a very real phenomenon.? Adoption of new technologies is very often found to occur in clusters where support groups occur. No-till farming, agroforestry, pasture-based dairy production, and management-intensive grazing are all examples of alternative production systems that have benefitted from local support groups.

Overcoming social impediments to adoption of new technology is often the most difficult challenge.? Whereas economic and bio-physical obstacles can be easily analyzed and logically addressed, many social constraints may not have rational bases or may be very nearly intangible. Emotional ties to past methods or fear of change are very hard to deal with as we serve as advisors to producers. Another aspect of social resistance to new technology adoption which is unique to the beef cattle-grazing enterprise is the lifestyle issue. The American cowboy is one of the most romanticised figures in our culture and is recognised almost worldwide as a symbol of American life. Even though the production system associated with the cowboy may be unprofitable and is perceived by some as being environmental- ly damaging, there are many landowners who have a farming enterprise primarily in order to display the image of being a cowboy. Technologies which might make their operation more profitable or environmentally sustainable, but would alter the cowboy lifestyle, are socially unacceptable to them. As more and more ranch land becomes a playground for the neo-cowboy, more and more land may be placed at risk environmentally as sound rangeland management is sacrificed for image and lifestyle.

A similar, but potentially less destructive trend than the neo-cowboy, is the shift of much grazing land away from traditional livestock production goals toward management for wildlife production. Technology that improves grazing lands for livestock production such as species diversification and planned rest and use periods also improves their value as wildlife habitat. Other grazing land management practices such as weed and brush control and excessive use of nitrogen fertilization may reduce wildlife habitat, however, on the other hand, abandoning all forms of weed and brush control may result in substantial loss of forage production and provide only mediocre wildlife habitat. Social considerations dictate a balance of technology use in addressing these sometimes conflicting goals.

Grazing survey

The grazing survey was prepared and sent to 100 State Extension Agronomists, Natural Resource Conservation Service Grazing Specialists and selected researchers throughout the USA. Participants were asked to respond to a series of questions as well as to rank items limiting adoption of intensive grazing (3). Response to the first question; "Has intensive grazing increased in your state since 1990?"? was an emphatic 100% yes.

When asked, "What do the producers who have adopt-ed rotational grazing believe to be the greatest benefits to the practice?" The number one factor listed was reduced cost of production, followed by improved production, increased forage availability, and higher gain per hectare. Other items such as better utilization of forage, improved carrying capacity, improved plant stand life, and extended grazing period were also high on their list.

Participants were also asked what they considered to be the number one limitation to the adoption of intensive grazing in their state. Participants listed an array of items concerning social, economic, and practical limitations.? Management expertise was listed as the number one economic and/or practical limitation followed by: labor requirements, fence system (cost), water availability, fence system (labor), and financial risk. The top social issues in order were: lack of understanding, fear of change, fear of loss of milk production, attitude of operator, and perceived increase in time and effort.

Summary

Amazing changes have occurred over the past two decades with respect to information technologies and technology transfer. From limited use of mainframe computers to the nearly ubiquitous presence of personal computers in all aspects of our lives today, information technologies now permit worldwide communication, collaboration on cooperative projects, and instant data transmission. The WWW offers tremendous opportunity to improve the efficiency and quality of the work we do. Our challenge is to develop the interpersonal relationships needed for collaborative work. In the final analysis we must assess the effectiveness and ask "What has happened down on the farm?" Our work suggests that to date nothing has replaced the effectiveness of one on one communication. We are reminded from surveys and personal experiences that "on-farm demonstrations" continue to rank number one among farmers and extension agronomists as the most effective technology transfer tool. Balancing these realities with reduced funding, personnel and time, will require discipline, leadership and creative uses of existing and emerging technologies.

In closing, I would like to leave you with a thought which I believe brings our discussion of technology transfer into perspective. Seaman Knapp, the originator of the concept of farm demonstrations made the following statement. "What a man hears he may doubt. What a man reads he may doubt, but what a man sees for himself, he cannot doubt." In addition to reinforcing the idea that farm demonstrations are a particularly effective tool, this statement supports the concept that there are limits to what can be accomplished with many approaches to technology transfer.

We have some wonderful technological tools, and their capabilities are expanding at a rapid rate, but they are still only tools. We must never forget that the ideas, the scientific expertise, the creativity, and the enthusiasm of scientists lie at the core of both technological advances and their widespread application in practical situations. No matter how sophisticated our approaches to technology transfer become, or how rapidly or easily they can be implemented, human inspiration and person-to-person interaction will remain essential to *Agronomy - Growing a greener future*.

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