INFORMATION: WHAT IS THE PUBLIC ROLE?

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The critical role of information and new technology as a source of competitive advantage and continuous improvement in business and financial performance has been recognized by farmers for years. U.S. farmers have been recognized worldwide as almost insatiable consumers of information and adopters of new technology. A significant factor in the dramatic productivity increase of U.S. agriculture during the past half century has been the information on new ideas and techniques that farmers have gleaned from both the public and private sector.

Knowledge and information has always been an important resource to business managers, but its relative importance has increased in recent years (Drucker, Peters). Whereas the physical resources of land, labor and capital combined with a bit of knowledge and information were the key determinants of financial success in the past, the role of knowledge and information has and will likely become more important in the future for successful management of a farm business. Superior knowledge and information will be the cornerstone for success -- it will enable the producer to obtain the physical resources of land, labor and capital and combine them in a efficient manner.

Not only is the relative role and importance of information and knowledge changing, the sources of that information for farmers is also going through a transformation process. Farmers have access to more information from the private sector (or from internal sources on the part of large scale integrated producers) and less from the public sector. In many cases, providers of key farm inputs such as pharmaceuticals and chemicals have become critical suppliers of information along with those inputs, leaving the traditional Extension Service and Land Grant/USDA complex at a significant disadvantage in terms of providing the latest knowledge, technology, and information. And larger and more educated producers who are becoming a larger proportion of U.S. producers rate traditional public sector information sources such as county extension agents and even University specialists significantly lower than many other sources of information for production, marketing or financial decisions (Ortmann, et.al.). These dramatic changes -- both in the importance of information and the preferred provider of that information raise a number of questions about the changing role of the public sector in the knowledge/information/data industry.

The role of information in the efficient functioning of firms and markets has been recognized by numerous analysts. Bonnen's seminal work on the role of the public sector in

data collection and analysis for the efficient and equitable functioning of agricultural markets and implementation of public policy is noteworthy. Various other authors have commented on the critical nature of price, volume and related market data to the effective functioning of individual product markets and to market economies in general, as well as the role of the public sector in providing unbiased, accurate market information (Purcell, Christy, Dobson, Riemenschneider, Grossman and Stigler).

From a different perspective, analysts with a decision theory focus have emphasized the role of data in firm decision making (Bessler, Arrow, Fishburn, Morgenstern, Eisgruber, Simon). Their basic argument has been that data or observations provide information by altering or confirming probability distributions of stochastic events that impact specify decisions, and that data has information value in proportion to the economic benefits of an improved decision based on that data. Additional perspectives of the role of information in firm decision making have been presented in the business management literature on strategic planning and competitive strategic advantage (Porter, Peters, Drucker).

The discussion presented here is more consistent with the decision theorists perspective of the role of information than that of market economists assessing market efficiency. The objective is to identify issues and specific questions that must be answered by public sector information providers if they expect to provide useful and valuable information for farm decision making.

What is Information?

The concept of information means different things to different people. In this discussion, we will distinguish between three important concepts -- 1) knowledge, 2) data, and 3) information. This distinction will not only assist in understanding the discussion that follows, but it can also be used to think about the role of the public sector and specifically the comparative advantage of the Extension Service in this industry. These definitions are an extension of Bonnen's arguments noted earlier.

Knowledge is the broad based concepts, theories, principles and models that are necessary to understand a particular phenomena. Knowledge can be applied broadly across many sets of facts and circumstances or contexts. It is not data specific or unique, but helps one sort through the vast quantities of data available to determine what is relevant.

Data are more specific than knowledge; they may be individual numbers or observations or data might be an individual idea or concept. Data can be quantitative or qualitative in nature. At the extremes data is distinguishable from knowledge in that data is specific while knowledge is general. Clearly this clean distinction becomes fuzzy at times.

Information is different from data or knowledge in two important dimensions: first it is context specific, and second it is decision focused. In essence, if knowledge and data are combined and applied to a specific context (for example, a specific crop and parcel of land)

and a specific decision (the proper level of fertilizer to apply to obtain a particular yield of a particular crop), they are transformed into valuable information. Data that is context specific and decision focused becomes information; information combined with knowledge results in improved decision making and better physical and financial performance.

Information has many attributes. It must be timely -- appropriate to the decision context and not out-of-date. It must be technically accurate and scientifically sound. It must be objective and unbiased, and/or value judgements must be explicitly identified. It must be complete (as opposed to partial) so as to be useful in a decision, or its partial or incomplete nature must be clearly specified. It must be understandable -- communicated in such a way that the user can comprehend it. And finally it must be convenient -- available when and where and at what time the user needs or wants it. These attributes will determine the value of information.

Although these definitions may differ somewhat from those provided by other authors, they will provide a useful context for the remaining discussion of the challenges facing the public sector in an increasingly complex information driven industry.

The Customer

Key questions for any provider of information are who are the customers, what do they want, and when do they want it? This is a particularly critical set of questions for public information sources such as the Extension Service. In contrast to most private sector information suppliers, Extension Services have not proceeded very far in data-based marketing and market segmentation. Much of the information is provider driven, not customer driven -- it is organized and packaged in disciplines or fields compatible with specialist training rather than integrated to solve the problems of customers or clientele. Extension Specialists have a significant amount of personal contact with their customers, yet don't appear to know much about the psycographic characteristics and decision context in which they will use the information provided. And consequently Extension Services do little to segment the market and tailor the information provided or how it is provided to specific customers with those characteristics and context.

Without a doubt Extension information/dissemination organizations are responsive to their customers or clientele -- if people don't come to meetings or request publications, we make appropriate changes. If people request programming, we try to deliver. And most Extension programs have a formal evaluation or assessment process to obtain feedback from the participants. But it is not clear that Extension programs are customer driven in the sense that those who deliver Extension information know their clientele intimately, can anticipate their needs, and have a system in place to regularly monitor their use and satisfaction with the information services. In essence, Extension generally responds to the criticisms of the product that has already been delivered rather than anticipate changes and the needed information product.

As one considers the attributes of information noted earlier, the ability of public sector information services such as Extension to deliver those attributes to the customer may present serious concerns. Without adequate research support, the information may not be timely -- it may be out-of-date. Some have argued that less of the research done in the Land Grant System is applied in nature; consequently it is less decision and context specific and thus useful to traditional producer audiences. Others have challenged our ability to provide information in an understandable fashion -- whether in written or spoken word. The discipline structure within the USDA/Land Grant System frequently results in incomplete information for the complex decision the user is making. And we don't compare very favorably to the convenience motto of the private sector electronic vendors of information (particularly market information) of anytime, anyplace, anywhere! The strengths of the public sector information system are objectivity and accuracy, but these attributes alone may not be sufficient as one considers the relative value of various sources of information.

A customer focus raises some very difficult questions for public sector information providers. Do we have adequate contact with the end-user of the information (the farmer in this case) to provide information with the attributes noted earlier, or would such contact on a personalized basis require resources well beyond most public sector budgets? If so, should we focus more on wholesaling information to those individuals who for other reasons have direct customer contact (i.e. consultants, professional service providers, and product/input sellers) and allow them to retail our information? What about charging for services -- an issue we will return to later? Some users can afford to pay and some cannot; should we differentially price and deliver information as a function of ability to pay? And what about unpopular messages which may increase as more regulations are imposed on the agricultural industry. How do you effectively deliver messages and information that the customer doesn't want to receive, particularly when they are paying for it?

Structure/Coordination

Significant structural changes are occurring in agriculture -- not only in size and ownership of farm firms but also in the linkages/coordination of farm production activities with input suppliers and product purchasers. More and more of these linkages are occurring through personal negotiated/contractual/ownership arrangements rather than impersonal open markets. Although numerous forces and drivers are contributing to these structural changes, information and knowledge play a significant role. As in other industries characterized by negotiated/personal linkages, those individuals with unique and accurate information and knowledge have increasing power and control in the food production system. And with power and control is the capacity to garner profits from and transfer risk to others with less power.

The increasing role that knowledge and information play in obtaining control, increasing profits and reducing risk is occurring for two fundamental reasons. First, the food business has become an increasingly sophisticated and complex business in contrast to

producing commodities as in the past. This increased complexity means that those with more knowledge and information about the detailed processes as well as how to combine those processes in a total system (i.e. a food chain approach) will have a comparative advantage. The second development is the dramatic growth in knowledge of the chemical, biological and physical processes involved in agricultural production. This vast expansion in knowledge and understanding means that those who can sort through that knowledge and put it to work in a practical context have a further comparative advantage. Thus the role of knowledge and information in success in the agricultural industry is more important today than ever before.

The logical question for individuals in the food manufacturing chain is how to obtain access to this knowledge and information. Historically, particularly for the independent producers in the farm sector, this knowledge and information has been obtained from public sources as well as from external sources such as genetics companies, feed companies, building and equipment manufacturers, packers and processors, etc. In general, independent producers have obtained knowledge and information from external sources in much the same fashion as they have sourced physical and financial resources and inputs. In contrast, ownership/contract coordinated production/processing/distribution systems have sourced their knowledge and information from a combination of internal and external sources. Many of these firms or alliances of firms have internal research and development staffs to enhance their knowledge and information base. And the knowledge they obtain is obviously proprietary and not shared outside the firm or alliance; it is a source of strategic competitive advantage.

Furthermore, the research and development activities in coordinated systems are more focused on total system efficiency and effectiveness rather than on only individual components of that system; it is focused on integrating the nutrition, genetics, building on equipment design, health program, marketing strategy, etc. rather than on the areas of topics separately. and in addition to more effective research and development, such alliances or integrated firms have the capacity to implement technological break-throughs more rapidly over a larger volume of output to obtain a larger volume of innovator's profits. In the case of a defective new technology, ownership/contract coordinated systems generally have more monitoring and control procedures in place and can consequently detect deteriorating performance earlier and make adjustments more quickly compared to a system with impersonal market coordination.

As knowledge and information becomes a more important source of strategic competitive advantage, those who have access to it will be more successful than those that do not have access. Given the declining public sector funding for research and development and knowledge and information dissemination which has been the major source of information for independent producers, the expanded capacity of integrated systems to generate proprietary knowledge and technology and adapt it rapidly enables the participants in that system to more regularly capture and create innovator's profits while simultaneously increasing control and reducing risk. This provides a formidable advantage to the ownership/contract coordinated production system compared to the system of independent stages and decision making. The

fundamental implication for public sector information providers is that they will face even more questions concerning open access to their information, constraints on availability, targeted audiences, etc. (i.e. who gets the information and at what cost) because of growing concerns about the structural implications and distributional consequences in terms of benefits and economic/political power of differential access to information.

Messages/Media

Much of the information that farmers have received in the past has been distributed through mass media formats including radio, newspapers, farm press, and similar media. A significant amount of Extension information has been disseminated in this fashion, as well as in print and publication form and in meeting formats that parallel mass media in that they are generic rather than narrowly targeted in terms of both audience and message.

Information needs of farmers will expand and will become less generic and more firm specific. Information will be obtained in various ways with the prospect for more electronic and less print/hard copy distribution systems. Information and messages will likely be transmitted electronically through individualized communication systems to producers in their cars, tractors, trucks, as well as homes and offices. In the not too distant future, producers will have access to individualized, electronic, real-time, personal message/information/communication systems. Some producers will have personal monitors which they will wear at all times to receive messages and communicate information; messages including advertising will be personalized with specific information made available only to individual customers/listeners.

The challenge of the mass media information distribution system will be how to combine the networking capacity of that system with the personalization of messages, not necessarily by individual producer but by more narrowly defined segments of producers. For example, corn growers need different messages than hog producers, and cattle feeders need different messages than milk producers. Information for some is noise to others. The information industry must and will determine how to target these specific messages to the right producers to be more effective in providing information, rather than providing a cafeteria of messages which the producer must sort through to obtain useful information.

To participate in this system Extension Services will increasingly need to segment the market and provide specific messages to more narrowly defined groups of producers. The mass media message will be too generic for producers who have unique growing or producing circumstances. The delivery system will have the capacity to provide personalized messages through a mass media distribution system, but a critical task in using this system is determining what specific bits of data or information (i.e. what message) individual producers want and need. The challenge for Extension will be to both access this distribution system, and to tailor the personal messages to individual listeners/users.

Public/Private Linkages

Producers can obtain information from public sources such as the Land Grant System and Extension Services as well as community colleges and high school and technical school adult education programs, and/or they can obtain information from the growing number of private sector providers. Private sector providers include those firms that provide information for a fee such as consulting companies, record keeping services, newsletters, and the rapidly growing number of electronic delivery systems and networks such as DTN and Farm Dayta as well as input supply firms such as seed and chemical companies that use information as part of their competitive strategy. In fact, more and more input suppliers are using information as a source of strategic competitive advantage; this information is not only in the form of advertising of product attributes, but is broader in focus providing management assistance for example in the form of crop scouting, soil testing and mapping, nutrient analysis, feed analysis, etc.

The rapid growth in private sector information services and providers combined with the declining support for public sector information sources such as the Extension Services raises important questions concerning the potential linkages between public and private sector providers of information. The issue of the Extension Service becoming a wholesaler rather than a retailer of information surfaces again. Should Extension train and provide information to private sector consultants, scouts and management specialists who then have one-on-one contact with producers and in this format provide more useful information to those producers because it is context and decision specific? Should Extension personnel train and provide information to technical representatives and sales personnel from input supply firms such as feed, seed and chemical companies who will then provide this information to individual producers? Should the Extension Service utilize the private sector electronic media as well as newsletters and print media as part of their information dissemination/distribution channels? What are the risks and benefits to the public sector of these linkages? Will objectivity be compromised? Will producers who can't pay for the service be deprived of the latest information? Who will receive the recognition and rewards for providing the information? What if the information is wrong -- who will bear the risk of errors and possible liability? Without these private sector linkages, will public information services be able to be effective?

These are difficult questions to answer, but one possible way to at least approach an answer is to return to the concepts of knowledge, data and information as defined earlier. As one thinks about the relative comparative advantage of the public sector vs. the private sector in this area, the public sector probably has a comparative advantage in analysis and integration -- in essence in knowledge. In contrast, the private sector probably has a comparative advantage in dissemination -- in data gathering and manipulation and providing information. To be useful in decision making, knowledge must be integrated with data and information. One of the significant advantages of public/private sector linkages would be to allow each of the sectors to exploit their comparative advantage by combining the analysis and integration capacity of the public sector (the knowledge component) with the

dissemination capacity of the private sector (the data and information component) to improve the information content and usefulness of the messages that producers receive.

Accuracy/Resolution

As has been noted earlier, data becomes valuable as information as it becomes context specific and decision focused. This concept introduces the challenges of the accuracy or resolution associated with data. In both crop and livestock production, data are becoming more unit or activity specific. For example, geographic information and mapping systems combined with guidance systems such as a global positioning system are being used to increase the resolution and accuracy in evaluating soil productivity characteristics and crop growing conditions by foot rather than by acre and make appropriate fertilizer, chemical and other management input adjustments to increase yield or reduce cost. This site specificity results in the potential for more precision crop farming. In similar fashion, the growth process of individual animals can be monitored with adjustments in feed inputs as well as preventive medications for disease triggered by in-animal monitors to optimize the growth process as well as the amount and location of deposition of lean vs. fat.

At the same time as our measuring and monitoring systems have the potential to become more site or unit specific and real time, the techniques for summarizing this data and converting it into decision focused information may not be keeping pace. For example, most standard farm accounting systems are driven by bottom-line, whole farm or enterprise financial results with significant lags in measurement. With increased capacity to measure and monitor the process of livestock or crop growth combined with increased emphasis on process control to increase efficiency and improve quality, more of the accounting/record keeping/data gathering activities must focus on process monitoring and measurement or activity accounting. This level of specificity and resolution is generally not part of standard accounting and data acquisition systems in agriculture.

In similar fashion, systems for gathering distributional information (rather than only point estimates) and using that distributional information in the decision process will become increasingly important to managers. Quality control and process monitoring concepts are based on assessing individual production units and measuring the distribution of desired attributes. Distributional information is particularly important with market information. Managers will become increasingly dissatisfied with point predictions of future prices and will request and be able to evaluate and analyze price probability distributions as they develop their marketing plans and strategies, just as they currently use weather probability distributions (weather forecasters now provide forecast data in the form of probabilities of rain as exemplified by statements such as a 20% chance of rain or a 50% chance of rain in contrast to more generic terms such as low or high) in production and work scheduling decisions.

But a point of caution on this issue of accuracy and resolution. Some decisions

require further refinement of accuracy and increased resolution; this is particularly the case with tactical decisions in the production and marketing area where there will be an increasing emphasis on process monitoring and control. Other decisions -- particularly strategic decisions -- may not require as much data specificity and resolution. One must be careful to not become immobilized in the decision-making process by too much data or too high a level of data specificity. And data gathering incurs a cost as well as a benefit. Thus, the level of data specificity must be matched to the decision that must be made, and the cost of gathering that data at increased levels of specificity or resolution must be compared to the benefits received.

Access to Information

With the increased context specificity and decision focused nature of information in recent years, it has become more valuable. And as information becomes more valuable, the incentive for the private sector to provide that information and capture some of that value increases. Consequently, growth in the private sector data gathering and information service firms is not surprising given the growing value of information.

But information can be a source of strategic competitive advantage as noted earlier. Those firms that can obtain superior information can act on that information and improve their performance compared to those firms with inadequate access to the latest and best information (and technology). Thus superior (better in terms of context specificity and decision focused) information is a source of competitive advantage to the supplier of that information -- allowing him/her to extract value or income from the user of that information by charging fees or maintaining or improving related product sales. And it also provides a competitive advantage for the user of that information -- in this case the producer -- in terms of better performance and higher profits compared to other producers.

Because of the increased value of information and the expanding role of the private sector in providing it, the issue of the proprietary nature of and access to data and information becomes more important. With the increasing value of information and its use as a strategic competitive advantage, there is less free exchange of data and information. And the issue of who owns the data and information becomes critical. For example, with respect to site specific soil characteristic information, who owns it -- the farmer who paid for it or the service company that gathered it? Can a farmer obtain this information from one company such as a fertilizer or chemical dealer and then provide it to a competitor who might have a lower price on fertilizer or chemical products? Does it make a difference if the farmer pays for the service and how much he pays or if the information service is provided as part of a bundled package with the product? If coordinated production systems have the potential to obtain superior information as noted earlier, how can a producer that is not part of that system obtain access to that or similar information to remain competitive? Will you need to become part of the system -- "in the loop" -- to obtain access to the latest information to be competitive?

In a broader context, the public policy issue of intellectual property rights and the role of the public sector in making information a public good that is broadly available to all potential users becomes critical. The intellectual property rights debate has historically focused more on research and development and new innovations protectable under patent or copyright law. Particularly in agriculture, the public sector has played a major role in the research and development activity and thus provided broad access to new technology and ideas. In this context part of the public purpose was developing and disseminating new ideas in a sufficiently broad fashion that a wide spectrum of users benefitted, and so that individual firms could not restrict access and capture the value associated with the new idea. The public sector role was that of leveling the playing field so that all participants competed on the same grounds vis-a-vis access to new ideas and information.

But as more and more of the research and development and thus new ideas come from private sector firms compared to the public sector, and more of the information dissemination system becomes privatized, individual firms have more potential to capture value at the expense of end users. They have the potential to restrict access to new ideas and information to particular users, thus favoring some producers and excluding others from the ideas, technology or information necessary for them to be competitive. The concepts of intellectual property rights including patent and copyright law as applied to agriculture were developed in an era of domestic markets and national firms; a relatively large public sector research, development and information dissemination system; and a limited role of information as a critical resource. These concepts should be reevaluated in the current context of global markets and multi-national business firms; the shrinking role of the public sector in research and development and disseminating information; and the increasing importance of information compared to other resources as a source of strategic competitive advantage.

Pricing/Incentives

As has been suggested in previous comments, information is increasingly valuable and a critical question becomes who captures that value. With a public sector distribution system that doesn't charge for information, the end user captures most of the value -- particularly the early adopter who uses that information to improve his financial and economic performance. If the industry is competitive with many participants as in agriculture, market competition will over time result in most of the benefits being captured by the final consumers - in our case the food consumer. If provided by the private sector at a fee or as a strategy to enhance or retain sales, the provider of information captures at least part of its value. This does not necessarily imply however that the user captures more value if information is provided by the public sector; that would only be the case if the value of information provided by the public and the private sector were identical. If the private sector information provider can increase the value of information by making it more context specific and decision focused compared to public sector providers, they could extract a fee for part of this value and still leave more value to be captured by the user compared to public sources of information. In this context, charging for information may provide the incentive to make it more valuable by enhancing its context specificity and decision focus.

The issue of charging for information services is extremely controversial in Extension programming. The tradition has been to provide most Extension programs on a free or nominal charge basis premised on the argument that public funds have been used to support the information development and dissemination system, and that charging for services would discriminate against those who do not have an ability to pay. In recent years, many Extension Services have faced tighter budgets and are implementing fee schedules for some information programs. Most of these fee schedules are based on partial or total cost recovery. Thus in the context of economic principles these pricing decisions are supply or cost driven.

But information like any resource has a supply and a demand function. And consideration of the demand or value function can be useful in resource allocation decisions. Market driven pricing based on the demand function provides information on the value of information, and is thus useful in making decisions about how to allocate scarce Extension resources to various forms of information programming. Markets provide signals and incentives to do the right thing; so pricing for services may not only assist in recovering cost, it may provide significant information that can be used to allocate resources to the highest payoff Extension program. In that context, pricing Extension programs might make a significant contribution to a demand/consumer driven public sector information system as contrasted with the current supply/provider/cost driven system of determining the proper types of programs.

Clearly, one must always be concerned about issues of market failure that would allow firms to capture excessive profits or exercise monopoly power in the information markets, and an important role of the public information system is to mitigate the impacts of those market failures. But one cannot ignore the potential failure of non-market allocation systems that do not recognize relative value in providing their product or service -- in this case information services. Markets and prices do provide extremely valuable data that can be used in making socially optimal resource allocation decisions, and this data should not be summarily ignored.

A Final Comment

The system and mechanism by which farmers obtain information to improve their decision making is changing dramatically. With increased context specificity and decision focus, information is becoming more valuable. Public sector providers of information have fewer resources. Private sector providers of information are expanding their activities and information has become a source of strategic competitive advantage for both farm input and service providers. Information is becoming more detailed with the potential for increased accuracy and resolution. Dissemination technology has reduced the cost of accessing information, and will make real-time personalized messages available anytime, anywhere, anyplace. Information is becoming an increasingly important driver of control and structural change in the agricultural industry, and access to information and intellectual property rights is becoming an increasing source of conflict and controversy as information increases in value and that value can be captured by private sector firms.

In this rapidly changing environment where the knowledge and information resource has become increasingly valuable to consumers, producers and society in general, the public sector knowledge/information system focused on agriculture in the form of the Extension Service and the Land Grant/USDA complex must reevaluate its changing role. This discussion has certainly not provided concrete answers to that new role. But by raising questions that will stimulate dialogue, it hopefully will contribute to a new vision of the public sector role in the agricultural knowledge/data/information industry.

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