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Department of Agricultural Economics
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AGRICULTURAL & FOOD POLICY CENTER

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ENLIGHTENED INTERACTION BETWEEN AGRONOMY AND AGRICULTURAL ECONOMICS*

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The agricultural programs at Land Grant Universities are in a state of transition. Traditional sources of students and funding sources are unable to support these programs at present levels of activity. In response, we see efforts to identify new sources of funds and students. The thematic content of these efforts range from an embrace with basic science to a greater emphasis on applications--from gene splicing to holistic management. This transition is unsettling. We are invited to de-emphasize successful and dependable patterns to enable the development of new and unproven ones. Changes in our activities disturbs our philosophic sense of where we fit into the grand scheme of things. As we are asked to contribute to society in vastly different and untried ways, we are less sure that our contribution is important or essential.

This transition invites and tolerates a lot of introspection. The leadership of your learned society has asked me to speculate about ways Agronomists and Agricultural Economists might work together better. I believe this thrust comes from a growing appreciation for holistic management or systems analysis. Most simply put, this refers to ways to put technology (perhaps from several disciplines) in a management context. This management context refers both to the decisions a firm makes as well as policy decisions made to manage public enterprise. Whether or not more was expected, my response is developed around this theme. Suggestions coming from this discussion are meant to compliment, not substitute for work in the more basic science areas.

This paper presents a summary of the forces causing us to change and an assessment of how we might develop a multidisciplinary response in both teaching and research.

FORCES CAUSING CHANGE

Most of the discussion and analysis of the Land Grant System relate to adapting the traditional (application-oriented) teaching-research-extension format to a modern industrial setting (Bonnen; Kohl, Shabman and Stovener; Knutson; Ruttan; and U.S. Congress, Office of Technology Assessment). Lurking in these discussions is the belief, or wish, that this traditional format is worthy and if adapted wisely and vigorously, it will be appreciated and supported by an industrial society.

It is possible that we will find the success of the Land Grant System to be a part of our American agrarian adolescence. As our economy and political system grow up, the center of gravity moves away from agrarian issues toward industrial and post-industrial issues. The agrarian sector programs may wither and virtually disappear (as one finds in other developed economies), leaving both higher education and research primarily in broad general institutions rather than sector-oriented ones.

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Why is the agricultural part of the Land Grant System under pressure at this time? The primary growth dynamics in our economy have come from non-farm sectors for several decades. The following observations among other influences may relate to timing.

Changing image of agriculture. After a brief period of euphoria during the late 1970's, the image of agriculture has suffered with the lengthening 1980's agricultural depression. Enrollment in agricultural academic programs is affected as is funding priorities for research. Overproduction and government supports suggest an overbuilt and sick industry.

Economic development leads to relative decline in traditional sectors. Economies become more diverse as development or growth occurs. All sectors, especially fundamental sectors like agriculture, become relatively smaller. Sector-oriented programs are more difficult to support politically.

Political time lags. Agrarian values and thinking may continue as long as a generation or more after people leave the country. The baby-boomers now coming into leadership are our first urban/suburban generation.

Public funding crisis. Rapid economic development after World War II brought a period of easy growth of tax revenues. Educating the very young population became a natural growth industry. Today we find that our population, our physical plant and our work rules are older and less competitive in the global economy. Tax revenues are harder to raise. As states and the federal government face great budgetary stress, more pressure is put on all programs. "Welfare state" programs for an aging generation are powerful competitors.

Changing nature of farm people. Most societies have a general instinct to encourage an adequate food supply as well as to nurture their peasants. The politically and economically independent, clean living, poor, hard working American family farmers are increasingly replaced by either complex businesses with assets in the multimillion-dollar range or professional people living in the country and operating part-time farms. In our condition of overproduction, neither of these stereotypes evokes much voter empathy. Most rural people are unrelated to agriculture.

University governance dynamics. In earlier times, fledgling Land Grant Universities involved few people and irregular governance procedures. They were easily and significantly influenced by external political forces. As universities grow and mature, their internal governance process becomes more regularized. A community of interest develops with its own dynamics and momentum. It is much less open to external political influence. In this setting, agricultural colleges and departments within them become less linked to farm or rural issues and more oriented to abstract science.

As these and other influences are studied, a consensus is growing that future political and economic events will be less encouraging for agricultural programs than conditions we have experienced over the past few decades. We have already seen erosion in financial support for teaching, research and extension. Enrollment is down. There is every reason to believe that most agricultural programs, including agronomy and agricultural economics, will not be supported in the future at the present level. Unless we can find a more useful product or service, our professions will experience major declines.

A MULTIDISCIPLINARY RESPONSE

During the first two-thirds of the twentieth century, science and technology experienced growth, success and many major accomplishments. The method of science was to focus knowledge and attention on a (frequently small) component or piece of a machine or system which was not working properly. Basic science was often used to understand problematic relationships and design solutions to problems. The improved component was then added to the conventional system with the usual effect of improved system performance.

In the 1960's John Kenneth Galbraith made the following observations:

> "Specifically, there is no way that organized knowledge can be brought to bear on the production of an automobile as a whole or even on the manufacture of a body or chassis. It can only be applied if the task is so subdivided that it begins to be coterminous with some established area of scientific or engineering knowledge. Though metallurgical knowledge cannot be applied to the manufacture of the whole vehicle, it can be used in the design of the cooling system or engine block. While knowledge of mechanical engineering cannot be brought to bear on the manufacture of the vehicle, it can be applied to the machining of the crankshaft....Metallurgical knowledge is brought to bear not on steel but on the characteristics of special steels for particular functions, and chemistry not on paints or plastics but on particular molecular structures and their rearrangement."

There is no expression of concern relating to the process of integrating these improved components into the whole. There is no problem where one improvement conflicts with or cancels another. This mentality has given an enormous stimulus to the "reductionist" method of science. It works well where the power of science to intelligently rearrange things is small and weak in relation to the systems to which it is applied. As the power of science increases, the problem of simultaneity emerges. Each change must be considered in the context of other changes and feedbacks or side effects. This situation has led to the evolution of "Systems Analysis" and "Holistic Management" in the last third of the twentieth century.

In this newer pattern, the reductionist science continues, but the context changes. Each participant has an awareness of changes or possibilities in other disciplines together with knowledge of feedbacks and side effects. As the power of science to intelligently rearrange things increases, the need for understanding feedbacks, side effects, simultaneous events in other disciplines and the general function of the system increases. Cars evolve improved aerodynamics, smaller engines, stiffer tires and improved suspension simultaneously. The smaller engines would not work without the improved aerodynamics and low-drag tires. The stiff tires are tolerable only with improved suspension. The selection, simultaneous development and integration of components for optimal system effects has moved from a non-issue a generation ago to the center of the stage.

If this rationale is applied to the programs of Agronomists and Agricultural Economists, how might it work? Lets imagine that through some magic we were able to eliminate all jargon based barriors to communication, set aside disciplinary chauvinism, and have unlimited insight! Unfortunately, my reaction is primative and simple. It has a common theme of management. The manifestations are somewhat different at different levels.

UNDERGRADUATE PROGRAMS

There is a large amount of turmoil in curriculum development within agricultural economics. I think it grows from changes in the fundamental vision of what we are doing. Traditionally we have set about teaching students our specialties without much thought to how or where they might use these skills. Farm management and commodity marketing were the early and continuing specialties and others have been added. Today, we find this pattern unsatisfactory. Placed in the context of a business firm, these and other specialties lead to staff jobs--not line or management jobs. Students are still interested in our specialties, but they want them to be placed in the context of business management. They want to be positioned to flurish and advance in business firms. This gives us a dual priority--business management and traditional agricultural economics subject matter. We are learning that the students prioritize business management higher than the traditional subjects.

There are many ways to deal with this dual priority. Current developments in our department have led to the definition of an "agribusiness block." This 18 hour unit of work includes basic learning in accounting, finance, leadership, marketing, management, and systems analysis. Math, computer and basic economics capability are prerequisit. We use this as a part of a B.S. in Agribusiness, but it is also set up to be available to students majoring in Animal Science, Agronomy or Horticulture, etc. Another level of the proposed B.S. in Agribusiness is the "specialty area." Specialty areas could be developed to provide traditional agricultural subject matter (agronomy, horticulture, animal science, etc.) in a management oriented degree. Therefore, this arrangement would allow putting some management in traditional degree plans or putting some traditional agricultural subject matter in a management oriented degree plan.

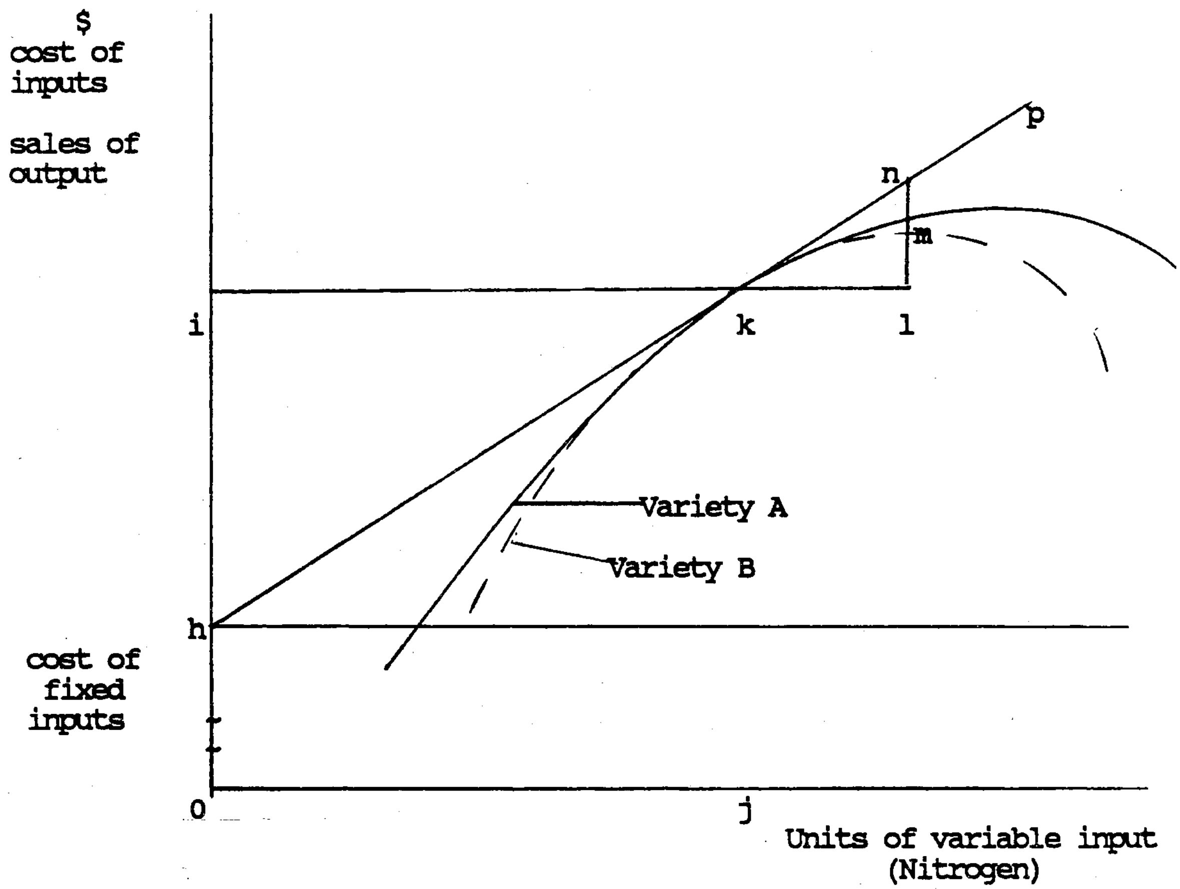
Several departments of agricultural economics present a "non-science" masters degree. These degree plans are often centered on agribusiness management. The flexability of these arrangements often permit combining traditional subject matter with management.

RESEARCH INTERACTIONS

The folklore of agricultural economics suggests that agronomists asking practical questions about costs led to the early development of agricultural economics! It is, therefore, clearly not pathbreaking to identify some of the fundamental and natural interactions between these disciplines. With appropriate humility, I will try to start at the beginning and bring the list up to date. The common theme here is to put agronomic activities in terms of dollars of costs and sales and learning the several reasons why outcomes don't follow quite parallel to the agronomic outcomes.

Maximum vs. Optimum Output. Superior new varieties of commercial crops are frequently identified by comparing yields. Cultural practices are fine tuned to produce the highest yield possible. While the resulting data may provide an indication of biological potential, a commercial producer would never find it feasible to produce at maximum output. Figure 1. shows this arguement more precisely. Consider this as an example of two genetically different test varieties. **0-h** is the level of cost for fixed input factors (land, water, etc.). **h-p** represents the sum of fixed costs and variable costs (nitrogen). This "total cost" increases linearly as units of the variable input are added. Varieties A and B respond slightly differently to different levels of nitrogen. However, the response curves (output in equilibrium prices) are both tangent to the cost line at **k**. This is the "optimal" output level because costs per unit of output are minimized. Total yield continues going up from **k** to **l**, but this is wasteful because **k-l** units of input gives only **l-m** output whereas it would give **l-n** output in optimal conditions. The higher total yield of A as compared to B is a false signal because it does not translate into a higher optimal yield.

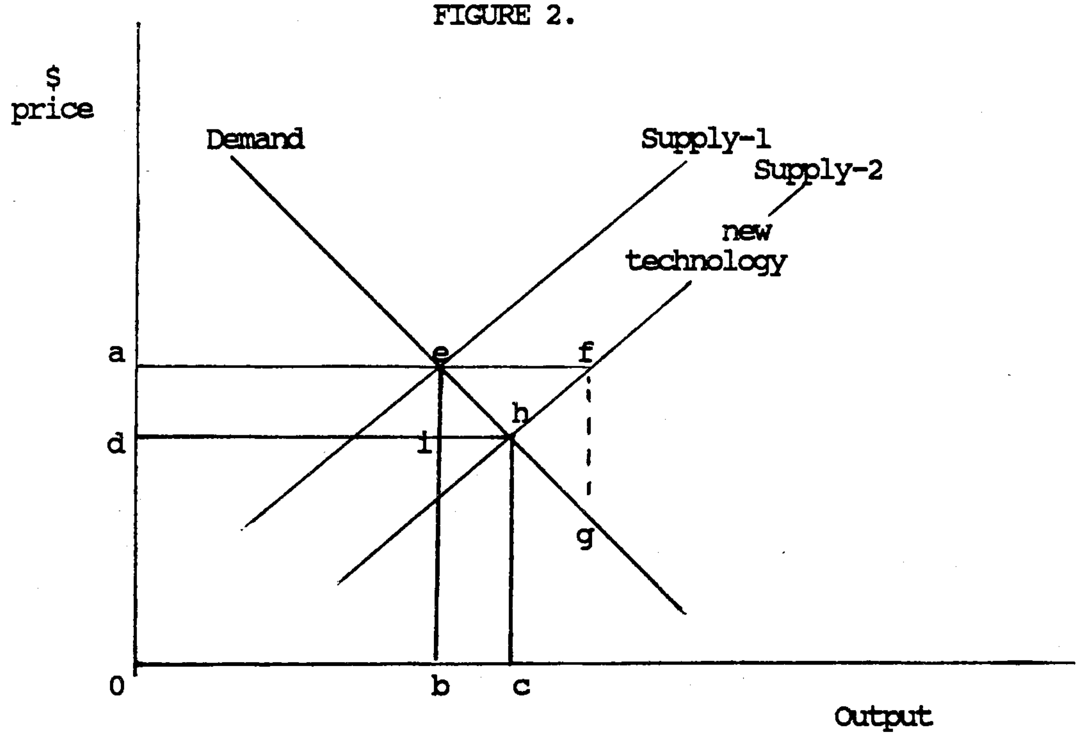
FIGURE 1.



Other Problems of Intensive Production. Higher yields may increase vulnerability to diseases and parasites. In cases of forage production, this problem applies not only to the agronomic level of the system, but also to the livestock level. It is astonishing how many ways exist to "grow more grass" in Texas—and how few of them are economically feasible (Conner and Chamberlain, VanTassell and Conner).

Supply Response. Things that are hard to produce tend to be more expensive than things easy to produce. It follows from this basic nature of things economic that **as we reduce production cost, value (price) will decline!** Figure 2. illustrates. In first equilibrium (Supply-1), Quantity **b** brings price **a.** When a new technology comes along, more production is brought to market. At the old price **a,** producers would be willing to increase supply by **e-f,** but that would drive prices down to **g.** The resulting new equilibrium (Supply-2), is the production of **c** output at **d** price.

FIGURE 2.



The Case of Inelastic Demand. Where goods are already inexpensive and in large supply, the total value of a large crop may be less than the value of a smaller crop. This is because the lowered price necessary to move the large crop into consumption adds less revenue than is lost when the price cut is taken on all units. This situation is illustrated in Figure 2 by comparing the gained revenue (the rectangle **bchi**) with the lost revenue (**aeid**).

Producer v.s. Consumer. The adoption of new technology in food production or processing may have little affect on producers but be very beneficial to consumers. In Figure 2, consumer gain is represented by **aehd** while producers experience a loss (**aeid-bchi**).

These arguements can be presented in many variations. The general theme is most important, however. It is clear that biological improvements in maximum yields do not translate into producer or public benefit on a one for one basis. At least three implications must be drawn from this theme:

1. There will be a need for disciplinary **and** multidisciplinary research for the forseeable future. One does not replace the other. Each makes the other more important.

2. Joint work involving Agronomy and Agricultural Economics can provide a basis for describing to the public the benefits of biological research. A great part of the glamour of the events currently going on in biological research will never be translated into commercial processes because of the points identified above.

3. Policy concerning both traditional agricultural commodities and the new biotechnology must be guided by an understanding of commercial realities. Agricultural Economics must be prepared to translate changing technology in Agronomy (or other disciplines) into commercial expectations as an instrument of policy analysis.

SYSTEMS ANALYSIS/HOLISTIC MANAGEMENT

The people and rhetoric involved in the undergraduate and research patterns discussed above are usually quite different. I want to assert, however, that I understand the underlying cause and the fundamental accommodation to be very similar. In both cases, we are putting an analytical process within a management context. The undergraduates know that the management process of importance to their career will most likely be a firm and they want to know the way it works. Our research, if it is worthy at all, probes the basic pivot points of our civilization. The management context here is public policy. We must be prepared to help society understand the practical effects of new technologies. This understanding, or the lack of it, will guide both how the public invests in research and how it uses the new technology.

CONCLUSIONS

If Agronomy and Agricultural Economics could harmonize our efforts perfectly, I doubt we could have the effect of reversing the "forces causing change" discussed above. Our time in history conditions many of the environmental influences amongst which we pursue our discipline. I do feel that we could achieve best results by working more together. At the same time, the ideal pattern of interaction is a constructive blend of disciplinary and multidisciplinary work for both of our groups. The uncompromised pursuit of our science and the multidimensional process of managing our public and private enterprise are both worthy objectives.

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