Update: Research Priorities

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During the last year, research priorities for animal agriculture have received much attention through committees, conferences and symposias. In all of these activities, research needs and priorities related to meat science and muscle biology have been one of the major aspects. Interestingly, these needs and/or priorities have frequently been addressed by scientists and administrators not closely associated with animal agriculture or meat science and muscle biology. For example, Dr. Philip Abelson, Editor of *Science* in a recent editorial (Abelson, 1980) discussed the role of cattle in supplying food, and the differences in fat content of forage-fed and grain-fed cattle. In an address to the May conference in Michigan on "Animal Agriculture—Human Needs In The 21st Century," Dr. Abelson posed numerous research topics that he felt should be of high priority to researchers in animal agriculture. One of these dealt with determining the biological reasons for why animals differ so greatly in their ability to convert feedstuffs into meat. At this same conference, Dr. Anson Bertrand, Director of Science and Education for the Department of Agriculture, spoke of the need for basic research on new ways to increase product shelf life, assure food safety, control the efficiency of converting feedstuffs into animal products, the need to increase "production efficiency" rather than production, and the need to reduce fat in the human diet, as well as others. Dr. Bertrand's closing statements indicated that federal research dollars should be put where: 1) the payoff is predicted to be the highest; 2) human needs will be met that are perceived by the public; and 3) some portion of the research effort addresses long-range speculation.

Finally, it should be noted that the outcome and recommendations of the ten working committees at the "Animal Agriculture—Human Needs In The 21st Century" Conference will be the feature of a symposium at the annual AAAS meetings in January 1981 at Toronto, and a future issue of *Science* will be devoted to animal agriculture. The ten working groups at the Michigan conference included the following topics:

- Human Nutrition
- Food Processing & Acceptability
- Food Safety
- Animal Nutrition
- Animal Genetics & Reproduction
- Animal Health
- Feed Production
- Production, Marketing & Distribution
- Resources & Environment
- Public Policy

A number of AMSA members served on some of these working groups, as well as other scientists from animal agriculture, producers, consumer representatives and health professionals. Each working group consisted of about 12-20 individuals from a variety of backgrounds. It was the intention of this conference to sample a cross-section of ideas in drafting research and public policy needs for animal agriculture, and then use this information to increase support for addressing these needs. Some of the needs which surfaced that are pertinent to meat science and muscle biology include:

- Reduction of fat and sodium content in meat products
- Improved methodology for determining nutrient analyses and bioavailability, as well as rapid methods to assess quality, safety and risk
- Optimization of product utilization through better control of spoilage and pathogens
- Effective methods for the safe use or disposal of what are presently considered unsafe products
- Cellular and hormonal processes associated with efficient animal growth and protein synthesis
- Criteria of merit for animal selection
- Ways to reduce the costs of marketing
- Evaluation of the criteria and effectiveness for government regulations, tolerances and standards
- Ways to improve energy utilization

Thus, it seems highly probable that the outcome of this conference and other efforts, such as the Intersociety Research Priorities documents, have made or will make an impact upon the research priorities and support for animal agriculture.

The results from the AMSA Research Priority Committee and discussion of Meat Research Priorities at the 1979 RMC were most helpful during this past year in making input into the Intersociety Research Priorities and various working groups at the Michigan conference. Since the research priorities of AMSA as well as ASAS, ADSA and PSA have been forwarded through the Intersociety Research Committee during the last two years, it seems appropriate that those most recently (November, 1979) forwarded to Dr. Bertrand be enumerated here. Since these have not been generally distributed, this will allow AMSA members to know what they

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were, and encourage suggestions for how they might be altered or improved. It is important to recognize that these are derived with all aspects of animal agriculture in mind. It is my impression that this joint planning on the part of research priorities for all four societies was viewed very positively by individuals responsible for priorities and budget proposals in USDA, as well as some representatives in societies not associated with the Intersociety Council. These priorities were presented to USDA personnel and other society representatives for the FY 1982 budget deliberations at a "Conference on Priorities for Agricultural Research, Extension and Higher Education" in Arlington, Virginia on January 27-28, 1980. A proceedings of that conference was recently published (April, 1980) by USDA-SEA. The Intersociety Research Committee Priorities document for research and higher education which was submitted is as follows.

Priorities for Animal Research and Higher Education

Introduction

The efficient production of animal products requires that the processes of reproduction, growth, lactation and egg production be optimized through an understanding and control of genetic, nutritional, physiological, environmental and health factors. Once the product (meat, milk and eggs) has been produced, then it must be prepared for delivery to the consumer in a form that is safe, nutritious, high in quality and appealing to the consumer.

Thus animal agriculture research and higher education needs have species and discipline considerations which are frequently unique. However, there are sufficient problem similarities among species and a need for interdisciplinary approaches that our four societies have beome involved in joint planning through an Intersociety Research council. This response to Dr. Bertrand's November 1979 request for information on animal agricultural needs is an example of such joint efforts. Because this is a joint reply from four societies, we have taken the prerogative of providing slightly more expanded "Program Problem Statements" than was requested. However, instead of listing a maximum of 10 priority programs, we have only provided our five highest research priority areas and the highest priority for higher education. The research priorities have been developed over the last couple of years and have been published as part of two Intersociety Research Committee Bulletins in a slightly different and more detailed form than provided here.

RESEARCH PRIORITY *ONE*

Program Title: REPRODUCTIVE EFFICIENCY

Program Problem Statement:

Increased yields of animal products depend largely on the animals' reproductive capability. No other single factor routinely influences the efficiency of animal production as much as the reproductive performance of the herd or flock. Research on problems of the kind described below would help increase the production efficiency and yield of meat, milk and eggs.

**Determine and control factors that influence fertility, fertilization rate, embryonic survival and hatchability.
**Find ways to increase the number of offspring per breeding female and learn to control the sex of the offspring.
**Continue to search for new and practical ways to detect estrus.
**Identify and control factors that cause seasonal breeding, or seasonal differences in reproductive performance.
**Seek new methodology and application of techniques to maximize the utilization of superior genetic stock.
**Determine ways to reduce the parturition interval.

Magnitude of Problem:

In poultry and wine, there have been reproductive problems associated with selection for meatiness, feed efficiency and/or growth rate. For beef cattle, it is estimated that the average calf crop is only 80% of its potential. Perhaps related is the fact that the average calving interval in dairy cows is 13.5 months compared to an ideal of 12 months. In sheep and to some extent in other species, there is the problem of seasonal breeding or differences in reproductive performance related to season. Even though swine give multiple births, only about 50 percent of the reproductive potential is realized. Furthermore, as animal agriculture has become more intensive and specialized, new management systems are evolving which raise new questions relative to reproductive and total animal performance.

RESEARCH PRIORITY *TWO*

Program Title: SAFETY AND NUTRITIONAL VALUE OF ANIMAL PRODUCTS

Program Problem Statement:

Consumers have the right to know that their food is wholesome and nutritious. Likewise, it must be recognized that animal agriculture cannot exist in the absence of all drugs and chemicals, either natural or synthetic. Therefore, the problem becomes one of how to successfully deal with their use or presence, and yet guarantee that a given animal product is safe and nutritious. This problem is not unique to animal products since the same situation exists for foods of plant origin. Examples of research that are needed to improve the situation are as follows:

SAFETY

**Develop methodology for the rapid detection of toxins, and chemical or microbial contamination.
**Determine the fate of common drugs, pathogenic organisms and microbial toxins in the animal, and under a variety of processing and home preparation procedures.
**Develop ways to minimize the microbial contamination of animal products with a goal of zero pathogens.
**Continue to examine the reactions, alternatives and use of food additives, such as nitrite, that are used in animal products.
**Investigate the biological basis for potential transfer of antibiotic resistance from animal to man.

NUTRITIONAL VALUE

**Determine how processing and packaging conditions can minimize nutrient losses and extend shelf life of animal products.
**Develop technology to reduce the sodium content of processed meat products and the caloric density of animal products through reduction of fat content.
**Study animal products in relation to the total nutrient requirements of infants, teenagers, adults and the elderly.
**Determine the role of animal products in supplying trace nutrients for the human diet.

Magnitude of Problem:

Even if no synthetic drugs or chemicals existed in the animal's environment, there would still be potential safety problems from naturally occurring substances such as aflatoxins. Therefore, because of the role of animal products in supplying nutrients to the human diet, we must through research find ways of guaranteeing in a realistic manner that animal products are safe and nutritious. Without animal products we would greatly increase the problem of providing human food because grazing lands, roughages and plant by-products can only contribute to the human food supply thorugh animals. Furthermore, animal products are the major factor in providing adequate protein, iron, calcium, vitamin B_{12} and other vitamins to the average U.S. diet.

RESEARCH PRIORITY *THREE*

Program Title: GROWTH AND FEED UTILIZATION

Program Problem Statement:

Improving the utilization and conversion of animal feeds into meat, milk and eggs is a primary goal of animal agriculture and has worldwide implications for improving the human diet. The following examples serve to illustrate the kind of research that is needed.

**Continue to evaluate new plant varieties and microbial or chemical treatment of plant materials relative to their utilization by animals.
**Identify biochemical and physiological parameters that can be used for selecting animals with genetically superior rates of growth and feed efficiency.
**Determine nutrient requirements of genetically different animals or body types, and reevaluate these requirements in relation to new genetic strains and management systems used for production.
**Determine the role of gastro-intestinal microorganisms on feed utilization and nutrient absorption.
**Identify and control factors that influence feed intake, digestion and nutrient availability.
**Determine the cellular and nutrient-hormone-metabolic mechanisms that divert feed nutrients into animal proteins or fat.
**Establish the role, mode of action and safety for potentially new feed additives that may improve feed efficiency and animal growth.

Magnitude of Problem:

Feed accounts for about two-thirds to three-quarters of animal production costs. A 10 percent improvement in feed efficiency lowers the consumer's cost by about 2.5 percent. Through animals, man is able to derive food from plant materials that would otherwise be unavailable. There is a growing need to use animals for food production from feedstuffs that are not used by humans. Furthermore, the composition of some animal products can vary in content of protein and fat. Ideally, this composition should be more closely controlled during growth to provide optimum nutrient composition and palatability.

RESEARCH PRIORITY *FOUR*

Program Title: PROCESSING EFFICIENCY

Program Problem Statement:

To varying extents, all animal products must be processed before they are marketed and consumed. These processes frequently require large quantities of energy, produce waste materials and potential environmental pollutants, and sometimes do not permit the fullest possible utilization of the animal products by humans. Thus, there is a need to improve these situations through research, some examples of which are as follows:

**Develop new alternatives for minimizing energy utilization during processing.
**Determine how animal proteins and other nutrients present in blood, whey, skin, egg shells and bone could be more fully utilized for human food.
**Develop processing procedures and equipment to prevent downgrading of product, and minimize product condemnation and microbial contamination.
**Develop methodology to increase the shelf life, maintain nutritional quality and reduce the spoilage losses associated with animal products.
**Determine and control processing variables that influence the quality, acceptability and palatability of animal products as determined by consumers.
**Establish principles and technology for successfully combining plant and animal food constituents into nutritious, wholesome and acceptable human food products.

Magnitude of Problem:

It has been estimated that the adaptation of some research technology to animal processing procedures could reduce energy requirements by 20 to 30 percent. Much fuller utilization of animal products in human food items by U.S. processors would greatly extend the present potential of animals to supply human food products. However, no matter how highly nutritious, safe, energetically or aesthetically appealing a food product may be, it must be appealing to the sensory evaluation of consumers. Thus, food that does not have sensory appeal, will not be eaten and therefore cannot be nutritious. Sensory appeal has generally been good to excellent for animal products, but problems such as development of off-

flavors during processing and marketing have restricted the production of some animal food items.

RESEARCH PRIORITY *FIVE*

Program Title: ANIMAL HEALTH

Program Problem Statement:

As animal production becomes more intensive, animal health problems become more apparent and critical. There is a need to determine management alternatives for minimizing health problems, and continue the development of new vaccines and drugs necessary for disease control. Healthy animals are a prerequisite for efficient animal production and wholesome animal products. Some examples of these research needs as they encompass genetics, nutritional, physiological and management aspects of animal production are as follows:

**Develop an improved understanding and control of non-infectious, metabolic disorders through management techniques or other mechanisms.
**Determine the interaction between nutrition, environment and parasites or diseases on the production performance of animals.
**Develop methods to establish animal resistance to mastitis or control of mastitis-causing organisms.
**Develop management procedures for effective control of pests, parasites and diseases.
**Develop methodology for enhancing immunity, detecting diseases in a practical manner and reducing the impact on animals for environmental stresses.
**Develop practical procedures to detect and protect against natural and synthetic poisons, and potential product residues.
**Determine the basis for genetic resistance to health problems and how this information might be applied to other such problems.

Magnitude of Problem:

In some species and at times within any herd or flock, animal health problems represent the single greatest economic loss to the producer. Sometimes these problems result in death losses, but even more common are the subtle losses related to reproduction, growth, lactation and egg production. In addition, parasites, some organisms, diseases and natural or synthetic residues in animal products may result in decreased product value or condemnations.

HIGHER EDUCATION PRIORITY *ONE*

Program Title: SUPPORT OF GRADUATE EDUCATION

Program Problem Statement:

Following World War II, there was generally an expansion of animal-related programs in universities and the animal industry. Many of the individuals hired at that time and who have made major contributions to animal agriculture are now retiring or nearing retirement. It will not be unusual for many departments or other units to have 25-40 percent turnover of people in the next 5-10 years. While this situation creates new opportunities for jobs and possible changes in program direction, a serious shortage of people in many areas of animal agriculture has become evident in recent years. This is not only the result of numerous job opportunities resulting from a large number of retirements, but also at least two other factors. One of these is related to the general cost of graduate training and research programs, which have become more expensive due to inflation and nature of the programs. This has placed a restriction on the number of individuals that can be adequately funded for assistantships, fellowships and research. The second factor is related to the fact that during the last decade, an increasing proportion of undergraduate and graduate students have come from non-agricultural or farm backgrounds. Thus, after completing a more traditional undergraduate and graduate degree in animal agriculture they are frequently not as qualified to perform in jobs related to production animal agriculture as the individual with an animal or farm background. This means that new programs must be funded and tailored for such individuals, if the job demand is to be met. However, the individual with animal experience has much less need for this kind of program, so more traditional programs must also be maintained. There may also be other factors involved, but there can be no doubt that the need for well-trained people in animal agriculture is *critical*, if we are to continue to make progress in providing consumers with animal products that are nutritious, wholesome and reasonable in cost.

Magnitude of Problem:

Without appropriate funding and attention, there will be severe shortages of people with appropriate training to perform the responsibilities required of many positions in extension, teaching, research and industry. These include county and state animal extension specialists, teaching animal production courses, conducting production-related research and serving as sales people or industry service representatives to increasingly sophisticated animal production units.

End of Intersociety Research and Higher Education Priorities

In addition to the research priorities, it should be noted that the Intersociety Research Committee was also asked to submit priorities for Higher Education. The single one submitted (above) was considered far more important than any other. During the last couple of years it has become increasingly difficult to find qualified individuals for many positions requiring advanced training in animal agriculture. At the Arlington conference in January 1980 with other society representatives, it became evident that this same problem is also common to other areas of agriculture. This is attributed to a large number of retirements and less than an adequate number of individuals completing graduate degrees. Thus, the opportunities for qualified individuals with advanced degrees in agriculture are excellent in many areas. This situation is apparently quite different from other areas of biological science where the supply far exceeds the demand (Somjen, 1980).

At this point, you may be wondering about how priorities for research, extension or higher education are used and to what extent they are effective. Realistically, we probably will never be able to judge how important an individual set of priorities are in the complex federal decision and budget-making process, because there are numerous inputs. However, I believe that currently it is clear that we cannot afford to believe that more progress can be made without them, than with them. As discussed by Dr. Ralph McCracken (1980), Associate Director for SEA at the Arlington Conference, priority signals are derived from the following sources.

- USDA Administration & the White House
- Office of Management & Budget
- Office of Science & Technology Policy
- Congress
- Professional & Technical Societies
- Concerns of Federal Action & Regulatory Agencies
- Joint Council & Users Advisory Board
- Various Studies, Reports & Symposias
- Commodity & Trade Organizations
- USDA Scientists, Staff Specialists and Managers

Thus, numerous inputs must be weighed, but as professionals and scientists we must recognize that if we have meaningful priorities, then these can serve to "seed" the priorities that are established and supported by other groups. Without the appropriate input from scientists close to an area, it is quite possible that the most appropriate priorities will never surface. The publications and priority documents of the Intersociety Council have attempted to provide this kind of input for animal agriculture. The conference on "Animal Agriculture—Human Needs In The 21st Century" and the publications resulting from it are another example of ways to provide information for the decision makers.

There are two other activities which are currently underway that relate to all dimensions of animal agriculture and should be mentioned here. These are the possible formation of a "Federation of Scientific Agricultural Societies" (FSAS) and a "National Academy of Agriculture" (NAA). Both of these have been discussed in more detail in the 1980 AMSA Research Priorities Committee Report. During the next year there will be additional discussion and consideration devoted to these organizations.

Conclusions

During the last couple of years, the need for priorities in planning and budgeting for agriculture research has become increasingly important in the competition for support and funding. Without well-articulated documents that address serious problems and human needs, groups or organizations will be less competitive for the funds that are available. In addition there is a need for coordinating priorities whenever possible among groups and organizations. Greater coordination of priorities among people closest to all aspects of a problem, generally results in a stronger position for the priority and increases the dimensions of its support. The Intersociety Research Committee Priorities is such an example. One reason for the interest in FSAS and the NAA, is to assist in formulating knowledgeable priorities or policies important to agriculture that currently are frequently addressed by individuals and groups unfamiliar with the consequences.

References

Abelson, P. H. 1980. Beef production and consumption. Science 208(4444) p.1.

McCracken, R. J. 1980. The science and education administration's budgeting and priority setting process. Proc. Conference on Priorities For Agricultural Research, Extension and Higher Education. p.16-28. January 27-28, 1980. Arlington, VA. USDA-SEA.

Somjen, G. 1980. Supply and demand of manpower in experimental biology. Fed. Proc. 39:2465.