SYMPOSIUM: MEETING THE INFORMATION NEEDS OF THE DAIRY INDUSTRY

Meeting the Needs at the National Level for Genetic Evaluation and Health Monitoring

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ABSTRACT

National dairy data can contribute to improved management decisions. Animals can be ranked nationally for selection decisions, and success of various management practices and environments in supporting profitable production and in minimizing disease incidence can be determined. Baseline information is useful for analyzing farm business status. Genetic evaluations depend on accurate recording of parentage, production, and environmental factors. Epidemiological data should be representative of the entire population. Data collection can be accomplished through periodic contribution of producer records to a central site or by national record keeping through service agencies. In addition to DHIA supervisors, who presently collect most dairy data, consultants and veterinarians also should contribute information. Surveys may be needed for some health and financial data. Collection of data from many sources can be made efficient by standardizing formats for data exchange. Present processing power of personal computers and availability of electronic linkages enable on-farm record processing. Regional processing centers could emphasize accumulation of national summary data and development and support of on-farm systems. With appropriate organization, the cost of contributing on-farm information to a national database should be small. Resulting management, genetic, and health information provided to the dairy industry should provide benefits sufficient to motivate financial and time investments by dairy producers.

(**Key words**: genetic evaluation, information, health monitoring, national needs)

Abbreviation key: NAHMS = National Animal Health Monitoring System.

INTRODUCTION

National programs for genetic evaluation and health monitoring serve the dairy industry. Animal rankings produced by the evaluation program can be compared across the country, and, through conversion equations, bulls from around the world can be ranked (10). Health monitoring programs provide the data necessary for international trade as well as baseline information for evaluating local conditions.

Evaluation and health programs require accurate, timely, and monitored data from the dairy industry nationwide. Dairy producers generate milk production data through their purchase of services from milk-recording programs such as DHIA. This producer-financed system is effective because users have a direct interest in making the program efficient to minimize costs and to manage their herds better. Some health information can be collected similarly. However, other sources, such as specific surveys, may be required.

Competitive economic pressures have led dairy producers to increase herd size and production in an effort to increase efficiency and to lower costs. These trends for large herds and high production per cow have heightened the importance of timely information. Future information needs will require rapid movement

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of data between source and processor as well as simple ways to extract needed information from differing databases maintained by data repositories.

CURRENT NATIONAL INFORMATION PROGRAMS

DHIA

State or regional cooperatives provide milk recording, component determination, and management reports for member dairy producers (7). Typically, a member of the field staff visits each producer each month to collect data and milk samples. Samples are sent to a testing laboratory for component determination. Milk weights and component information are entered into a database at a computing center, and reports are mailed to the producer. About 80% of herds also have milk tested for somatic cell count as an aid in mastitis control (18). To reduce the cost of milk recording, some producers collect the milk samples themselves or have only one milking per month supervised instead of all milkings in 24 h. Custom reports can be generated to support many management activities.

Breed Associations

Breed associations (registry societies) maintain national herdbooks for each dairy cattle breed and also conduct visual appraisal programs for linear type traits and final score. The registration process requires permanent identification of the animal through tattoo, sketch, picture, or ear tags. Databases of production and type information are maintained, and reports are prepared for members. Official pedigrees that include genetic and phenotypic information on several generations of ancestors are used in marketing animals. Breed associations cooperate with DHIA in operating some production recording plans. The associations also maintain information on genetic defects and establish testing procedures and reporting requirements.

National Association of Animal Breeders

The National Association of Animal Breeders, which is composed of AI organizations, maintains a database of all bulls used in AI. This database includes the bulls' current status, assigned code numbers, and type of progeny-testing program. The National Association of Animal Breeders also manages calving ease evaluations for Holstein and for Red and White AI bulls based on data collected through member organizations and collects some information on genetic abnormalities.

USDA-DHIA Evaluations

The Animal Improvement Programs Laboratory, ARS, USDA, calculates genetic evaluations semiannually for production traits as part of a research program to improve the efficiency of dairy production. A database of lactation and pedigree information from DHIA and breed associations is maintained (20). This database is accessible for online query by dairy records processing centers and breed associations. Data are provided for specific research projects.

National Animal Health Monitoring System

The National Animal Health Monitoring System (NAHMS) is an information system designed to collect, analyze, and report on animal health events. The purpose of this voluntary cooperative project among food animal producers and their associations, university animal health specialists, and government animal health personnel is to provide information on interactions among animal health, production, welfare, product wholesomeness, and the environment. Traditionally, NAHMS has provided information on trends in animal health, economics, and producer management practices to support analyses, decisions, and actions by dairy industry groups through large national studies of the primary animal agriculture commodities, including dairy. The National Dairy Heifer Evaluation Project (15) is an NAHMS report. More recently, NAHMS has become involved in the collection, analysis, and interpretation of data from other sources. The NAHMS program uses a stratified random sample of producers in participating states that keep daily records of all events related to animal health that occur in their operations. The information is entered into a data base and used to generate reports for farm

management improvement; disease prevention, control, or eradication; and special studies (S. Wells, 1993, personal communication).

National Dairy Database

The National Dairy Database is a collection of information that is useful for improving dairy production (3), including educational materials produced across the country and handbook articles. Available electronically, the database has powerful computer search capabilities that can be used to find the appropriate information. Multimedia aspects are being developed.

MOTIVATION FOR NATIONAL INFORMATION PROGRAMS

On-Farm Needs

Herd Management. Profitable management requires information for decisions on which animals to keep, what and how much to feed them, and what treatments to apply. Complete and accurate historical information can help with all these decisions. Information on past events enables detection of trends and facilitates early action. Information on nutritional content of recent harvests can be used to formulate least cost rations. A single repository for management resources simplifies finding information for decisions.

Breeding Decisions. Breeding decisions are the basis for creating the next generation of a herd. They include when to breed cows and which bulls to use. Accurate records of calving dates and estrus are necessary for high breeding efficiency. Selection of service sire can include consideration of many traits. Selection can be at two levels: periodic purchases for the whole herd and allocation of semen from one of these sires to mate a cow. On a herd basis, high standards for overall merit are important and should be based on an economic index that is appropriate for the marketing conditions expected when the progeny are producing. Young bulls in progeny-testing programs can make an economical contribution to the herd breeding program, and their offspring can provide information necessary for future genetic improvement.

For selection of which bull to use with a particular cow, inbreeding and calving ease are probably the most important considerations. Because progeny from related mates are expected to suffer inbreeding depression, the merit of a bull depends on the mate for which he is being selected. Progeny from a mating between full siblings are expected to produce 565 kg less milk per lactation than if their parents had been unrelated (13). To avoid calving difficulty in primiparous cows, birth records for a bull's mates can be used to determine which bulls are more likely to sire progeny that will be born easily. Corrective mating for type traits also is often practiced but has not been shown to make an important contribution to profit (9).

Economic Planning. As farms increase in size and competition forces them to become more efficient, economic planning becomes more critical. Enterprise information is necessary for planning, and feed and labor costs are probably the most important. Good records and accurate analysis of feed ingredients enable maximum benefit to be derived from the feed. Questions about size of business can only be answered accurately with an adequate cost basis that can be scaled.

Baseline Statistics for Problem Determination. When a farm business is being analyzed, statistics for similar businesses are valuable for comparison. These statistics enable determination of potential problem areas and provide information on what level of performance can realistically be achieved. Information on disease incidence can help to determine a treatment or control protocol. Information on the most successful operations is particularly useful for setting goals and targets.

National and International Needs

Marketing Statistics. National programs require data to manage agriculture successfully nationwide. Programs to control supply depend on forecasts of agricultural production. The cost of price support programs must be predicted. Export promotion programs are related to the amount of surplus production.

Trade Health Requirements. As exports become an increasingly important contributor to agricultural income, meeting the information requirements of importers is necessary. Health issues have been a substantial barrier to trade.

With adequate information on the incidence of various diseases, facilities sometimes can be located to meet the health requirements of importers.

Benefits

The justification for a national program is that pooling of data across farm and region is necessary as a basis for informed decisions to maximize individual and national agricultural efficiency and profitability. Genetic evaluations are a clear example. By pooling data, an animal's rank within the North American cattle population can be determined. A national program simplifies collecting all information on animals because some AI organizations have national sampling systems and daughters of a bull may be widely distributed. A national system also is able to exploit all ties among animals, which enables accurate ranking of widely separated animals. The ability to compare animals is extended internationally through conversion equations based on bulls with daughters in more than one country (11).

National data are useful for detection of broad trends in contrast to individual farm or regional concerns. National statistics also can be used for planning, decision making, and export enhancement. The National Agricultural Statistics Service of USDA collects census data useful for planning. The major responsibility of this agency is the collection and publication of current statistics on the nation's agriculture. Major program areas include agricultural estimates, statistical research, and service work that entails surveys and data collection.

INPUT DATA

Collection

Data collection usually involves periodic contribution of producer records to a central site. The most widespread milk-recording program for dairy cattle is DHIA, in which a supervisor visits the farm monthly to record milk production, to take a sample from all the milkings during 24 h, and to collect status information that has accumulated since the previous visit. There are many variations on this plan (1); for example, in a.m.-p.m. plans, only one milking is supervised and that milking alternates monthly. Involvement of the supervisor is required for data to be used in national genetic evaluations. In some plans, data collection is by the owner.

Consultants and veterinarians can also be a source of data. Large dairies often have nutritionists and veterinarians under contract. These service providers could electronically access the data of their clients and add information on health events and feeding information. Information from the records should help in developing management recommendations, and the information added would contribute to national programs as well as herd management.

For some purposes, specific surveys are best for collecting data. The National Dairy Heifer Evaluation Project, a recent NAHMS study (15), was based on information from 1811 farms selected to be representative of farms with ≥30 cows. The most efficient scheme is to have some information collected routinely and to use surveys to collect specific additional information when needed. Routine collection is necessary if values on specific animals are needed (e.g., for genetic evaluations); surveys may be sufficient for some economic studies if the economic relationships are not expected to change rapidly.

Electronic transfer of data holds the promise of simplifying data collection and improving data access. Data transfer can be automated to reduce transmission costs and to use off-peak computer time (6). Electronic connections can be complex to establish and subject to various outages. Adequate user support is critical.

Advances in biotechnology will enable learning about the productive potential of animals through analysis of their DNA. Routine reporting of DNA analysis will provide the data necessary for including this information in genetic evaluations (4, 5). Breed associations have taken the lead in collecting these data.

Quality

The usefulness of the output from national programs depends on the quality of input data and the organization of the system. Quality also depends on the personnel expertise and controls built into the program. With DHIA data, the supervisor plays a key role in ac-

curacy, completeness, and timeliness of data. Training programs should emphasize the purpose of the data as well as the importance of thoroughness in data collection. The supervisor also can assist dairy producers in making maximum use of the data collected. Problems can only be corrected if they are detected, and an interested, knowledgeable user is an asset in finding data errors.

For genetic programs, parentage information is critical. The animal model is able to link information from all relatives (19). If sire or dam identification is incorrect or missing, accuracy is diminished. Identity information is most accurate if it is recorded at the time the dam is inseminated and if it is retained throughout the life of the animal. At birth, several methods are used to identify the calf, including ear tags, sketch, picture, brand, and tattoo (2). Implants and electronic ear tags are desirable means of identification because they can be interrogated electronically. Current identification practices could be improved by tagging both ears as insurance against tag loss and by national recording of identification information at tagging. National recording is particularly beneficial if most herd replacements are purchased. The importance of timeliness of recording is fully recognized in The Netherlands where identity must be recorded within 3 d of birth (8).

With production data, the challenge is how to maintain or improve accuracy while reducing cost of testing. Milking systems are available that can electronically identify cows and can store in a computer a record of each cow's daily production. These systems are expected to improve in their ability to identify cows correctly and to recognize unusual production patterns that suggest that the cow needs attention. Collection and identification of milk samples continues to be labor intensive. Programs are being developed that have less frequent sampling, and interest in including milk-only records in genetic evaluations is increasing. Accuracy may also be improved through better detection and use of abnormal observations. Comparison of lactation curves within herd may be a basis for excluding atypical data (14).

Genetic evaluation of production traits depends on comparisons among cows producing in the same environment. Therefore, data must also be collected on herdmates so that a cow can be evaluated appropriately (19). Cows receiving special treatment should be compared only with other such cows. Evaluations could be improved by knowing to which permanent herd strings the cows are assigned. Differences in management that occur in high and low production strings do not require specification if assignment is performance based; that is, if every cow has equal opportunity to stay in the high group if her production is high enough.

Standardized data exchange formats also can contribute to quality if they reduce confusion in data transfer among cooperators. As data processing capabilities becomes more widespread, many different kinds of participants will need to know how to use and contribute data. Software vendors will be better able to serve this market if data format standards are in place. The International Standards Organization publishes standards that apply in many industries to facilitate data exchange and computer interpretability. The International Standards Organization and the International Committee on Animal Recording are developing design criteria for standardized data exchange and performance standards. The exchange methodology Agricultural Data Interchange Syntax was approved by the International Standards Organization in 1993.

Electronic connections among computers promise to simplify the maintenance of national databases. Because of the many levels of interconnected computers (e.g., regional dairy records processing centers, state or local associations, and individual producers), a hierarchical scheme in which data are concentrated as they move through the system is needed. For example, DHIA data entered on the farm either by farm personnel or a supervisor during a monthly visit would be validated at a regional processing center and then relayed to USDA.

Distribution

Information systems are being developed with data distributed between the local user and the central computing center. This model places considerable computing power with the user, which gives the user rapid response and local control. Data also are distributed so that queries receive rapid response, and the central data server is freed from many routine transac-

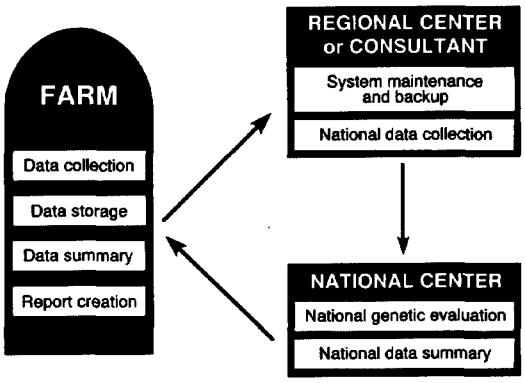

Figure 1. Hypothetical distribution model for dairy information.

tions. A distributed model system could be applied to dairy information as shown in Figure 1.

GENETIC EVALUATION

Genetic evaluation is based on comparison of performance of different animals in the same environment and on pedigree relationships that associate those differences with the animals that are genetically related. To calculate reliable evaluations, similar environments must be identified, production traits must be measured precisely, and animal identification (pedigree) must be accurate. Other information required to adjust data properly for influences not accounted for by the statistical model (19) include frequency of milking (16) and cow's age and month at calving (17). Additional information about the cow's environment, including string membership and treatments that affect production (such as bST), could help refine the selection of contemporaries. Status information also is important for assessing longevity. Knowing the reason for no further milk records is important. Culling, transfer to a nontesting herd, or discontinuation of herd testing can lead to different conclusions about a cow's herd life.

The accuracy of comparisons may be improved by analyzing monthly sample day production rather than lactation production (12). A sample day model is better able to account for environmental factors that affected the cow when she was actually producing the milk. Sample day production could be collected through monthly data transfers. Such monthly transfers have value even for lactation records because they allow data checks and inclusion of records in progress for more frequent evaluations. Analysis of sample day production would increase data processing time, and a method to combine new sample day data with existing lactation data would be required. Lactation records might still be used widely even if genetic evaluations were based on sample day data, because lactation records condense the data and thus make them more manageable.

HEALTH AND DISEASE MONITORING

National health and disease monitoring is of value to the dairy industry. Data gathered through such a monitoring system can be used to analyze risk factors and economic costs associated with health events. These data also can provide information for decision making by research, industry, and animal health officials and can support actions by dairy industry groups. Recognized needs of health and disease monitoring systems include standardized diagnoses of health events; cooperative producers as data collectors to recognize, record, and share information; and an efficient method of capturing data (i.e., electronically). Because of the technology explosion in dairy operations, the capability now exists to capture a mass of data from a large number of herds and to compile these data into a useful information resource. Therefore, careful and deliberate thought about the quality of available variables and their relationships is important to ensure that the information generated is both useful and timely.

With increasing consumer concern about the safety of the food supply, especially chemical residues, careful records of disease treatment become vital. On a national basis, information on disease incidence can contribute to designing eradication or abatement strategies. International sales may depend on information on disease incidence and accuracy of reporting. Health statistics can be an important aid in enterprise planning.

DISTRIBUTION OF INFORMATION TO USERS

Information must be distributed to be useful. An electronically connected dairy can gain

access to nearly unlimited amounts of information. The challenge is to determine where and when to access needed information. For other users, DHIA distributes reports monthly that could also include genetic evaluation information. The Extension Service has been a critical mechanism for improving agricultural productivity. Agents are an important source of information and can assist in locating experts to assist in problem solving. As dairies have increased in size, consultants have become more important in dairy management and can serve as information distributors. Because they are specialists, consultants are likely to be aware of a wide variety of information sources in their area. Because consultants charge fees, dairy producers are likely to consider their recommendations carefully.

The National Dairy Database (3) was developed to provide information on many topics associated with dairying. This project has received strong support from Extension agencies across the country because of the need to share educational materials. Few states are able to carry out a comprehensive program themselves and, therefore, benefit from having a common resource. This National Dairy Database is distributed on compact disk with search software. Current technology enables slide sets and graphic displays to be integrated with text. This medium may be suitable for distributing time-sensitive data such as genetic evaluations because of its high capacity and relatively rapid production possibilities.

CONCLUSIONS

National programs exist to meet dairy producers' needs from herd management to export enhancement. Complete, timely, and accurate data must be provided and results distributed quickly for national programs to generate useful output. Genetic evaluations require accurate pedigree information so that information on one animal can affect evaluations of all of its relatives. Appropriate contemporaries must be identified so that genetic and environmental effects can be separated. Verification of data collection contributes authenticity to the system, an important consideration because evaluations are a factor in determining an animal's economic worth.

The current information system is evolving to improve connectivity so that data can be delivered more quickly, turnaround time reduced, and overall system efficiency increased. Survey information can be useful periodically to detect trends and to establish baselines for planning.

Data are required at the national level for research on genetic evaluation methods, calculation of national evaluations, management of progeny-testing programs, and generation of statistics to characterize the dairy industry. Organizations that operate at a national level include breed associations, the National Association of Animal Breeders, AI organizations, and public sector research organizations, such as USDA's Animal Improvement Programs Laboratory.

Further benefits possible from national data include information on fertility of daughters of individual bulls, disease resistance, and herd life. Evaluation programs for some of these areas are being developed. The value of tracking fertility will increase with frequency of data collection because the fertility of a bull changes with time and with handling and processing procedures.

All data collection systems have to balance accuracy and completeness with cost. For example, genetic evaluations would be more accurate if animals were better identified and components were sampled monthly for all cows. However, efforts to improve animal identification or participation in test plans frequently have not been fully successful because of additional testing expenses, educational needs, and competition for management time. For an informational system to be successful, the benefits to management from data quality, quantity, and distribution must clearly outweigh any financial and time costs associated with equipment and labor.

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