RECORDING DAIRY ANIMALS FOR PROGENY TESTING-AN OVERVIEW

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INTRODUCTION

Importance of progeny testing as a method of genetic improvement of traits for which both sexes have genes but outward expression is limited to females (e.g. milk yield), is well established. Situation in Pakistan is also changing. The old scenario that bull's role is to make females pregnant, a pre-requisite to get milk from a cow or buffalo, is fading. Artificial Insemination (A.I.), which makes the job of genetic improvement easier is being considered not just a technique to reduce the cost of pregnancy and elimination of contagious diseases but as a tool to test and select dairy sires and cows. It may be emphasized that the naive idea of equating A.I. to breed improvement has altogether been rejected in favour of reality that breed improvement has nothing to do how females get pregnant (A.I. or natural mating). It is the genetic ability of the parents that makes the offsprings better or worse than others in the population. Selection of bulls through progeny testing, although, requires infrastructure for performance recording, increases the generation interval, needs persistent policies (can not be abandoned and restarted), still has been the main reason for per cow improvement of more than 100 liters every year in American Holsteins.

Fig. 1 represents the relationship between the three main components of dairy cattle breeding, removing anyone will hamper the process of improvement. As recent advances in molecular genetics also hold the promise of evaluating the quantitative trait value of segments of the chromosome (Soller, 1990) and are likely to bring the cellular level biotechnology into the genetic evaluation of animals, the pillar of quantitative genetics would thus change to quantitative and molecular genetics in the future.

Performance recording of animals especially at field level is both challenging and rewarding. Although, performance data can be collected from institutional herds or the research stations in the public sector yet, limitation of raising huge number of animals for this purpose is prohibitive. Also, as outcomes of animal testing are to be applied to the field animals, models developed and animals tested should include the field buffaloes and cows. An example would be a sire whose semen is to be used for making field buffaloes pregnant. This sire can only be declared better or worse if its daughters were recorded in the field under management conditions, similar to the future daughters of the bull. A better reliability of the breeding value of the bull can thus be achieved by having more number of daughters raised under various managemental conditions. Farm and field performance data are thus needed for designing and executing any meaningful breeding programme.

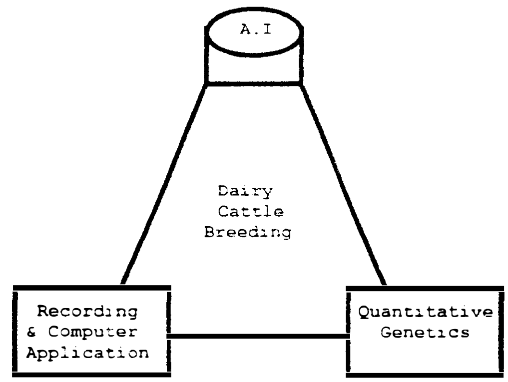

Fig. 1. Dairy cattle breeding today.

What constitutes performance

The basic criteria for any trait to be included in the definition of performance is its economic importance, at present or in the future. The reason for this is that every time a trait is added, some pressure on the previously chosen traits has to be reduced. For any trait to be considered in selection of dairy animals, following general conditions should thus be met (McDaniel, 1976).

1. Does improvement in it lowers cost of producing milk or meat from dairy animals (i.e., economic importance) ?
2. Does it have sufficient recognizable genetic variation that it can be changed ?
3. It is or can it be measured on enough animals so that accurate genetic evaluation is possible and economically feasible ?
4. Is improvement in it not genetically associated with deterioration in some other important trait ?

Yield traits

Milk yield is the most important of the yield traits and is currently being recorded at institutional herds at a specified interval. The time and interval of recording however, vary greatly from daily recording to monthly recording. Insonsistency also exists for different species. This perhaps is due more to the manpower availability than difference in perceptions regarding the accuracy for lactation yield estimated at varying intervals. McDaniel (1969) reviewed sixty research reports dealing with the estimation of lactation milk yields from samples taken at various intervals and concluded that alternate AM-PM recording was adequate. Recording monthly was determined 95% as accurate as the daily recording and economics of recording would allow tolerance of inadequacy of 5%. Kaura *et al.* (1983), and Dass and Sharma (1994) recommended twice a day field recording of buffaloes at a 30 day interval. Dev and Garcha (1988) also suggested AM or PM recording according to season for buffalo milk recording. Kumbhar *et al.* (1995) have also suggested four weekly test interval for recording Red Sindhi cows. Most of the production testing programmes now a days use AM-PM recording at approximately monthly intervals.

Milk recording, both for morning and evening milkings under field conditions, is difficult especially, the morning milking. Severe weather conditions making it even worse. Khan *et al.* (1997c) explored the feasibility of estimation of lactation milk yield from once a month, morning or evening, records only. Using complete lactation records of Sahiwal cows various test plans for predicting lactation yield from partial records were compared. Recording morning and evening milkings at a monthly interval was used as a standard (AM-PM plan) for comparison. Cows on an average produced 8.6% more milk in the morning as compared to the evening milking. Based on correlation between actual and predicted milk yield, AM plan was generally better than PM plan while correlations for alternate AM-PM plan were also comparable. Standard deviations of biases (difference between actual and predicted milk yield) were lowest for the standard AM-PM plan while highest values were observed for the alternate PM-AM plan. Proportions of predicted lactations falling within a range of ± 10% of the actual lactations were around 70% for the four plans as compared to 78% for the standard plan. Lactation milk yield could be fairly accurately predicted from alternate AM-PM plan as well as PM plan for use under the field conditions. Studies to develop models for various recording plans for buffaloes and the crossbred cattle are underway.

Morning and evening recording at a monthly interval would thus be adequate for cows and buffaloes under our conditions. In the start however, procedures such as alternate AM-PM recording for first 4-5 months of lactation would be adequate. The precaution would however, be that interval for such recording be 23-37 days (i.e. 30 ± 7 days) at random for any buffalo or cow. The relaxing factor of a week would help to allow the recorders to adjust for any public holidays, weather severity or other unknown emergencies. Precise factors for adjusting such records can be worked out from buffaloes and cows at institutional herds and some have already been published (Khan *et al.*, 1997c). A format for collecting data at field for buffalo is presented in Fig.2 and 3. The recording of time as shown in the performa for test day information (Fig. 2) is important to adjust the records to 24-hours interval. Again, studies are still required for adjusting yield for different milking interval. The flexibility from 24-hours interval is necessary to get the accurate records as it is rather impossible to force the farmer to milk the cows at an exact time. Also, if milking interval is not 12 hours, recording the time for milking prior to the milking being recorded would also become important.

At the processing and reporting centre, the information recorded on every animal would be adjusted for environmental variables such as frequency of milking, milking interval, age, stage and season of calving etc. The end product being a mature equivalent record usually called 305d-2X-M.E. Choice of the base age for buffaloes to calculate mature equivalents and adjustment factors for age at calving adjustment have been presented earlier (Khan *et al.*, 1997a). Similar factors for lactation length adjustment have also been worked out (Khan, 1997). Other parameters of individual lactations as well as lifetime parameters would also be estimated at the data processing centre. Cows and bulls' ranking on transmitting abilities for various traits and indexes would be required. Sire summaries would need to be published periodically for advertising and promotion (locally and for international market) as well as for feed back to the farmers for the purchase of semen. For international market however, bulls would be required to be free from known genetic defects, an area untouched so far, and a challenge for the researchers and planners. Procedures for Animal Model evaluation of Sahiwal cows and Nili-Ravi buffaloes have previously been suggested (Khan *et al.*, 1997; Khan *et al.*, 1997b).

Fat percentage has previously been recorded at some of the institutional herds but such recording has not been persistent, the few reports published provide some basic information on both Sahiwal and Nili-Ravi (Shah *et al.*, 1983; Hasnain and Shah, 1985; Iqbal, 1996). As the farmers or at least milk collectors are being paid for this yield trait, it can not be left out. The procedure of recording would not be different from that of the milk yield except that a representative sample of morning or evening milk would be collected by the recorder and processed at the centre/subcentre or to be sent to the central laboratory for analysis. Due to comparatively higher percentage of fat, buffalo milk quality deteriorates quickly. Preservatives such as potassium dichromate can help to keep the consistency of the milk if required. The traditionally used Gerber method can be replaced by machines such as Milkoscan which uses infra red rays to measure milk fat (Fabbri and Villa, 1991)

Protein and otherconstituents may be recorded in the long run when automatic equipment can be made available, but may not be included at this stage as it can delay the execution of any such performance recording programme. Milk samples of Italian buffaloes are routinely tested for protein as reported by Fabbri and Villa (1991).

Reproduction

Reproduction has a high economic value because it is necessary for initiation of lactation. Bulls differ in their fertility under A.I. conditions. For cows, information at breeding about the date of breeding and the identification of bull is important. At calving, date of calving, calf identification, calf condition including its weight and problems related to calving need to be recorded. Calving difficulty is recorded in advanced production systems but data are not available for cattle and buffalo for this trait in Pakistan. Generally, however, this does not seem to be a problem. Institutional herds can do such recording so that heifer's matings can be planned.

Type data

The physical appearance of the animal usually gets such more important than any other quality including the milk yield. Yet information on the dairy breeds of cattle (Sahiwal and Red Sindhi) and buffaloes (Nili-Ravi and Kundi) is not available. The term 'breed type' is commonly used to described the physical characteristics of animals for a given breed. Breed type would include the desirable characteristics of conformation (such as colour, size, shape, style, and many other traits) plus the specific characteristics that distinguish one breed from the other. A good example of this would be the term 'Punj-kalian' which distinguishes Nili-Ravi breed from other breeds of buffalo. The type generally refers to the ideal or standard of perfection which combines all the body characteristics. The economic value of type may vary a great deal from one location to another and is different from milk production as its value is nearly the same on all farms in a market setup. Also, type is measured by subjective judgment (i.e. beauty is in the eye of the beholder) as opposed to milk yield which is measured objectively.

For type evaluation, bulls and cows get different weightings for different categories (Table 1). The final score is expressed as a number with grades as Excellent, Very Good, Good Plus, Fair or Poor. Individual traits thus need to be defined. The linear scoring programme such as the one adopted by Holstein Association of US, can provide a framework for evaluating animals more precisely by simplifying

Traits

Such a scoring resulted in more consistent scoring (higher heritabilities) with more variation (effective selection). The Herd Linear Summary Graphs providing a graphic comparison of herd average versus breed average can be an important tool for farmers to decide the "keeps" and "culls".

Table 1: Relative importance of different categories for typing cows and bulls

Cows	%	Bulls	%
Frame	15	Frame	30
Dairy character	20	Dairy character	25
Body capacity	10	Body capacity	20
Feet and legs	15	Feet and legs	25
Udder	40		

Holstein Association (1995)

For cattle, information on other developed breeds can be helpful but for buffaloes, the challenge is even greater. A score card proposed for Indian buffaloes (Saini *et al.*, 1988) gives different emphasis to different categories of traits. The 100 point score cards was partitioned into general appearance (30), dairy characteristics (20), body capacity (20), and mammary system (30).

Other traits

Milking characteristics such as milking speed are important. Soft milkers are usually valued more than the hard milkers because of discomfort attached to milking the hard animals by hand. Temperament has also been attached a lot of importance. This may be important if animals are allowed to suckle for letdown of milk and if calf dies, animal goes dry. Also, management of dairy animals by woman attaches an additional value to the trait. Similarly, disease traits are also recorded in advanced recording systems and information such as somatic cell counts is routinely collected to select bulls for mastitis resistance. These and other such traits need the attention of the researchers but may not be included in the production recording schemes in their inception.

Animal identification

One of the most important function of any dairy recording programme is animal identification. Daily management decisions concerning breeding, feeding, selection, calving and culling depend upon accurate identification of animals. Proper identification is necessary for registration of animals with the purebred cattle associations and for keeping records of cows on production testing programmes (Schmidt *et al.*, 1988). Problem of misidentification of animals in the developed world is still unresolved. Van Vleck (1992) referred a German study that as many as one-six of all A.I daughters are misidentified as to the sire. A similar situation was feared in the US animal industry. As the advanced methods of animal evaluation, such as Animal Model use all known relations, breeding values of animals can be quite misleading and incorrect if identification system is not adequate. In US, individual cows are identified at the herd level by a barn name or number which is cross listed at the regional dairy record centre with a herd control number to assist in dairy records processing bookkeeping. The control number is cross referenced to a permanent identification for cows that are registered with the breed association. Metal ear tage numbers are used for permanent identification of cows without a registration number. Cows may also be identified with removable electronic ID units carried around the neck or in the ear. The barn name or number is usually associated with a neck tag or an ear tag to provide visual verification of the identity of individual animal. A final means of identification is either a sketch of color markings or an ear tattoo. All these methods are cross listed with each other and recorded in the databases where sire and dams are also recorded for use in genetic evaluation. Under Italian situation, several sires are raised together with females for the natural service, making it difficult to identify the sire of any buffalo calf born. To verify the paternity of the animal DNA fingerprinting is expected to be used in the future (Fabbri and Villa, 1991). This describes the importance of pedigree information in animal testing programmes with cattle and buffaloes.

Every animal should thus have a permanent identification number in the form of ear tag which can be cross-referenced with some other means of identification whenever required. This may be called as registration number. The number should tell the breed of the animal (e.g. SL for Sahiwal and NR for Nili-Ravi, S and N may also serve the purpose), the year of birth (e.g. 97), the location code (which may be centre/subcentre or some code for a particular farm or even an owner, e.g. B for Bahadurnagar if the animal was first registered from this farm) and a three digit serial number which can identify animals born within a year (order of birth or purchase etc.) for any location/owner/farm. An example would be S97B001 should indicate an animal of Sahiwal species, born in 1997, registered from Livestock Experiment Station, Bahadurnagar and had a serial number 001 given to it. The animal should have the serial number on it in the form of some ear tag, neck chain or freeze brand. The advantages of some identification types over others have been discussed by Schmidt *et al.* (1988). Thus for a given location, the animals can have the same serial number after some 999 registrations from that location. The above suggested number system can be expanded to eight digits if required. For example if case of four digits for serial number and two digits for location. The old method of numbering animals to show quarter of year of birth (1.7, born in Ist quarter of 97) does not provide additional information if birth year is known. Also, animals born at a distance of 10 years can be allotted the same number.

The individual record sheet for any animal should have a sketch for right and left side of that species along with a sketch of the face. At the time of registration, sketch of animal's color markings should be drawn on it. This should help in the identification. A specific name given to the animal by the owner should help is distinguishing the individual animals.

Other information

Effective recording system would also require that other than animal's own identification number, name, color etc., information should be recorded on:

1. Sire and dam identification.
2. Birth date of the animal
3. Traits of economic importance (milk yield, fat yield etc.) along with the dates of measurements and time of sampling.
4. Dates of calvings and drying.
5. Known environmental and managemental effects e.g. farmer's category.
6. Reproductive performance including the identification of the calves born and the bulls used as mate.

7. Growth traits like birth weight, weight at weaning, at first breeding and calving etc.
8 Vaccination and treatment records for various diseases.

Minimum number of daughters to be recorded for any bull is also an important issue to be considered in any recording program. Genetic gain can be improved by optimizing accuracy (daughters per bull) and intensity (choosing the topmost bulls). As an example, if 1000 daughters can be recorded, first extreme situation can be 100 daughters per bull (i.e. 10 bulls to be tested). In the second situation, 10 daughters can be recorded for every bull (i.e. 100 bulls to be tested). Now if the requirement of the breeding programme, is to retain only five bulls (depends on the number of services required, rearing and collection/storage facilities etc.), the genetic gain would almost be double in second as compared to the first situation. The optimum daughters superiority would however, come at the intermediate accuracy of 25 daughters per bull and selection intensity of 1 out of every 8 bulls tested. For smaller populations an optimum number of daughters per bull has been suggested to be 20 to 30 daughters per bull tested after random mating of test bulls. For larger populations, 50 or more daughters have been suggested by Schmidt *et al.* (1988). Another consideration in this context would be the distribution of daughters in one or several herds. Generally, if daughters of a bull are distributed in more herds, accuracy of breeding values would be higher as compared to distribution in few herds. Defining herd or more precisely herd-year-season (contemporaries) would still be very important in making valid comparison among bulls and issue has been discussed for Nili-Ravi buffaloes (Khan *et al.*, 1997b) and Sahiwal cattle (Khan *et al.*, 1997c).

The challenge of performance recording is to be met by realizing that initiation of such an effort needs religious zeal and zest. The low educational level of the farmers, less qualified extension workers and recorders, few incentives to the farmers, small herd size, lack of realization of need for progeny testing and the current poor data collection and processing are not all the problems. They are challenging but not impossible to cope with. Every developing nation faces such problems. Management information systems such as developed by Dairy Herd Improvement Programme Action (DIPA), India (Trivedi, 1996) and others can be looked into for comparison. Performance recording requires sustainable efforts and can not be done in bits and pieces. Let's do it to make this nation self-sufficient and beyond.

RECOMMENDATIONS AND CONCLUSIONS

1. Studies required to make any recording scheme to fulfil the future needs of animal testing include:
a) Heifer and calf growth charts, similar to Holstein and other developed cattle breeds (Hoard's Dairyman, 1990) for determining the efficient weight and age of breeding heifers. Indirect assessment of body weight from different body measurements is also required as direct measurement at field level would be difficult.
b) Definition of management types based on the herd size, profession, land holding or some other criteria.
c) Definition of linear type traits and development of score cards for type scoring dairy cows/buffaloes and bulls.
d) Development of models to evaluate animals genetically under the prevailing situations of husbandry.
e) Improvement of identification systems, acceptable to farmers.
f) Data generation to develop factors to standardize for milking interval to 24 hours.
2. Recording programmes should be taken up only in compact areas where adequate extension service including A.I. is available or can be provided.
3. Choice of the farmers is important. Willingness to participate actively, and possessing preferably, a larger animal unit. Data collection would be less costly and cow family information can help to increase the reliability of sire proofs. Incentives to the farmers can also be helpful.
4. Realistic choice of traits in terms of manpower and other resources as over burdening data recorders can lead both to misinformation and disinformation.
5. As in such programmes the persons who actually do the job are the performance information recorders, their training should not be overlooked. Adequate funding for their travel for performance recording and feedback to the computing/processing units should help.
6. Reduction in less fruitful reports of public institutions. The monthly, bi-monthly, quarterly, biannual, and annual reports take a lot of time and resources. Only information used for future planning be sent to other offices.
7. Modification in the recording procedures at public institution. Accuracy and improvements should be in the light of electronic needs of processing and evaluation.

Fig .2 Monthly production recording sheet

Animal Reg. # Location/Herd Farmer/Onwer
Birth date Name Characteristics
Sire Dam Location #

Test	Date	AM			Date	PM			Status[1]	Remarks & Signs
		Time	Milk	F %		Time	Milk	F %		
1										
2										
3										
.										
.										
.										
10										

[1]Status: OK =every thing fine , S =Animal was sick , D=letdown not proper

Fig. 3 Lacation Performance Sheet*

Animal Reg. # Lacation/Herd Farmer/Owner
Birth date of cow Name Side and face
Sire Dam Sketches

L #	Recor Type[I]	Calving		Completed lacation				305 -days or less		
		Date	Code[II]	Days	Milk	F %	F Kg	Milk	F %	F Kg
1										
2										
3										
.										
.										
.										
10										

[I]A = AM only ; P = PM only ; Aam = alternate : AM -PM ; AP =A< -PM plan
[II]N =Normal calving ; B = Started with modulation
*Service reocrd and distance and vacination record may be on the revcerce ; side of these sheets.

8. Simplification of the recorded procedures of field, which should involve little 'paper work' for the farmer.
9. Improvement in the animal identification system to have qualities of permanent identity, being legible at a distance, inexpensive, easy to apply, minimum pain or discomfort to the animal, conform to coding for data retrieval, and be difficult to alter, destroy or lose.
10. Development of programmes for farmer participation and development of breed associations and breed societies.
11. Farmers' education to avoid preferential treatment of daughters of any bull for unbiased ranking of animals, making them feel that they are the ultimate beneficiaries of the project.
12. Periodic re-evaluation of the strategies of recording and implementation.

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