*Production, Reproduction, Veterinarian

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The cattle industry today is facing several challenges. The humanitarian call for more and better food at prices making it available to all people is more insistent than ever before. Public demand for beef and dairy products is increasing with rising affluency in both developed and developing countries. Statements made at recent world food and nutrition conferences seriously questioned the significance of livestock agriculture for human nutrition. Competition between animals and human population for plant protein and other nutrients was one of the arguments presented. It was also stated that animal proteins are not essential for human health and welfare. Whatever their validity, these statements ignore reality. Not less than 70 percent of agricultural land in the world is not suitable for grain production. Conversion by ruminants is required for utilization of this vast area. In view of energy crisis dependence on biological fertilizers, principally animal waste will increase. Nevertheless, this challenge exists and will have to be met. Inflation and the prevailing economic climate has not spared the cattle industry, narrowing further the already narrow margin of profitability of beef and dairy operations. In several countries profitability is maintained by government subsidies.

Livestock operators are responding to this challenge by increased awareness of the role of economics and production efficiency. In fact, the last decade has witnessed a dramatic trend in this direction. Economy and production-efficiency oriented livestock operations are replacing farming motivated by family tradition, sentiment and pride at a rapidly accelerated rate. This phenomenon is not limited to countries or regions with intensive cattle farming nor to large commercial operations. A recent Kiplinger Agricultural Letter forecasts that this trend will accelerate. It also stated that progressive producers have to function principally as "money managers" with economic considerations influencing operational decisions. Livestock operations are complex and involve several disciplines beyond animal husbandry and agronomy. Only a few, if any, producers are competent in all of them. Expert advice is therefore sought when needed. The extent of utilization of experts, however, is determined by cost effectiveness of their services. Veterinarians in this setting belong to expert teams and are expected to serve as economic advisors on animal health and function as it relates to production. For economically effective contribution professional competency alone does not suffice. To fulfill the role of economic advisor a veterinarian must have at least working knowledge of economics of livestock operations. Familiarity with income and expense columns is required for identification of items needing attention. The following table gives main income and expense items and identifies those which can be influenced by veterinary services.

Gross Income	Production Expenses
Marketable Product* x Price	Capital Investment Operational Expenses Labor Feed Maintenance Financing Livestock Expenses*

In the basic equation (net income = gross income - production expenses) prices and to great extent production costs are beyond the control of producers. In addition, the production costs per producing unit remain largely constant. Net income, consequently, depends on volume of marketable products, which can be economically increased only by improved production efficiency of individual producing units. This is an area which is controllable by producers. Production efficiency depends on genetic production potential, feeding, health and reproductive performance. Among these the latter is the most important single determinant. In simple undisputable terms milk production is initiated and maintained at optimum level by parturition. Replacements and feeder units are produced by pregnancy. In addition poor reproductive performance does not permit full utilization of advanced knowledge in genetics, nutrition, management technology and veterinary medicine. Moreover producers are becoming increasingly aware of the significance of reproductive performance on the economic efficiency and refuse to accept poor reproductive performance as unavoidable "bad luck."

Poor reproductive performance exerts its adverse economic effect in many, often interacting ways, including: reduced calving rate or annual calf crop; delayed and protracted calving seasons; reduced single and lifetime lactation; increased age at first calving; reduced utilization of production potential;

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restricted voluntary culling for genetic upgrading by selection; increased involuntary culling; and increased capital investment and financing for procurement of replacements.

Attempts have been made to document the magnitude of the economic loss. These efforts have met considerable difficulties resulting from the multiplicity of the effects and a multitude of management-dependent variables. All-inclusive studies are but a few, notably those of Conlin (1973), Burton *et al.* (1976) and Zeddies (1976). All three pertain to dairy cattle and express the loss in monetary terms, of limited value for assessment in an international setting. This is unfortunately true for a majority of other reports dealing with selected parameters.

The scope of this presentation does not permit a comprehensive review. It is, therefore, limited to selected studies.

Annual calf crop or calving rate is a commonly used fertility index used as an intermediary step in estimating economic loss due to poor reproductive performance. The following table correlates annual calf crop with calves born and weaned in a theoretical herd of 100 females of breeding age. It is based on assumptions of a sex ratio of 50:50 and a peri- and postnatal death rate of 10%. The latter is conservative. Wiltbank, *et al.* (1967), reported 11-12% loss in beef cattle. According to Speicher and Hepp (1973) and Hartman, *et al.* (1974), it exceeds 15% in dairy cattle. The sex ratio of 4:6 favoring female calves in incidence of stillbirths has been disregarded in preparing the table.

Annual Calf Crop and Calves Weaned

Annual Calf Crop (%)	Calves Born (N)		Calves Weaned (N)	
	Fe	M	Fe	M
100	50	50	45	45
90	45	45	40	40
80	40	40	36	36
70	35	35	31	31
60	30	30	27	27

These figures are self-explanatory. Warnick's (1967) calculations imply that in order to realize net gain in beef operations the annual calf crop has to exceed 65%. Beef calving rates of 75-85%, 74.3-86.1% and 80% are given by Warwick (1967) for Canada, New Zealand and Argentina, respectively. Wiltbank *et al.* (1967) reported a range of 62-93% for USA. These data are based on recorded information, principally from research stations. Much greater variation and lower rates can be expected in operations without records.

Annual calf crop appears as an index, supplementary to calving interval, in calculation of economic impact on dairy operations. Nevertheless, the number of calves born and weaned is highly significant. It is generally agreed that effective genetic upgrading by selection requires a voluntary cullng rate of 25%. Involuntary culling due to reasons other than production averages 15%. Considering replacement needs alone, the number of calves born and weaned is economically highly significant.

Calving interval and days open have been used to determine the effect of reproductive performance on lactation. Interrelationships between lengths of dry period and lactation and lactation curve compound calculations and may account for differences in data reported. Louca and Legates (1968) reported an average loss of 2.5 kg milk and 0.1 kg butterfat per day open during the 48-month period following first calving. For second and third lactations the loss per day open was 3.58 and 3.68 kg, respectively. Morris (1971) reported a difference of 64 lbs. of butterfat produced at calving intervals of 12 versus 14 months, averaging .48 kg of butterfat loss per day of extension.

Milk Marketing Board (1965) estimates a loss of 6.5 kg of milk per day of increase in calving interval from 12 to 14 months. Esslemont (1976) recorded an increase of 2.7 gallons (12.25 kg) per day resulting from reduction of days open. In addition to lactation loss, extension of calving interval reduces the annual calf crop in a dairy herd. According to Conlin (1974) and Morris (1971) the calf crop decreases by 8% and 7.7% per month of extension.

Pelissier (1972), Spike and Meadows (1973) and Spalding *et al.* (1975) reported average calving intervals of 13.5 months in cattle herds they surveyed. Similar data have been obtained by the author and in other studies. Zeddies (1976), in a comprehensive study, found calving intervals less than 369 days in 51% of 1,499,655 animals studied.

The authors cited and studies not included in the bibliography agree that calving intervals of 13 months in primiparous and between 11 and 12 months in adult cows are associated with highest milk yield. Reproductive performance goals for production efficiency are essentially similar for dairy and beef operations:

Annual calf crop or calving rate	90<%
Calving interval	
First parity	13 mos.
Subsequent parities	11-12 mos.

According to Perchner and Lush (1959) genetic traits account for only 10% of variations in calving interval, the remainder being management dependent. Gestation length being constant, only the open period is subject to management efforts. The length of open period is determined by the interval from calving to first service, conception rate and to some extent by embryonic deaths. To achieve these goals management efforts must be focused on each of these factors.

The interval from calving to first service depends on the length of physiologic anestrus and heat detection. Effect of management on the former is limited. Reviews by Hansel (1959) and Graves, *et al.* (1968), reported 55 and 54 days as average time of first postpartum heat in dairy cattle. According to Foote (1975) the first estrus occurs slightly later. This time corresponds to the 47 to 60 day period calculated by

Touchberry, *et al.* (1969), as required to attain 365-day herd calving interval at 60% first-service conception rate. Thus physiologic basis for achieving the goal of 12-month calving interval exists. Early breeding experiments reported by Olds and Cooper (1970), Anonymous (1971-1972) and Whitmore, *et al.* (1974), indicate that, although first-service conception rates are lower, almost 90% of animals conceive before 90 days postpartum. Early breeding is therefore a practical and economic procedure for reduction of open period. The key to success however is estrus detection and timely therapy of abnormal animals. The role of estrus detection is obviously restricted to artificially inseminated dairy and beef cattle. Barr (1975) reported an estrus detection rate of 47%. Somewhat higher–51 to 52% efficiency–was recorded by Stevenson and Britt (1977). Esslemont and Ellis (1974) calculated the effect of estrus detection rate on calving interval assuming a 50% conception rate from first services on day 60 postpartum. Estrus detection rates of 50% and 80% resulted in calving intervals of 382 and 366 days, respectively.

The effect of estrus detection is by no means limited to detection of postpartum heat. It affects both service intervals and conception rate. Spalding, *et al.* (1975), found service intervals of 41 and 40 days between first and second and second and third services. Olds (1970) reported an average service interval of 47 days. Pelissier (1972) calculated that one out of six heat periods are missed. Zemjanis, *et al.* (1969), reported considerably higher incidence of postservice (30.8%) than preservice (12.6%) anestrus.

There is strong indication that mistimed services resulting from inadequate estrus detection are principal causes of conception failure in inseminated herds. Williamson, et al. (1972), found that 12% of animals presented for A.I. were not actually in heat. Milk progesterone studies have corroborated this. Thus Hoffman, et al. (1976), reported that 13% of animals tested had progresterone values exceeding those found in estrous cows. None of these animals conceived.

Studies in laboratory animals indicate that gamete aging results in embryonic deaths. This has not been documented for cattle. It is, however, highly probable that mistimed services have similar effect in bovine species.

To attain reproductive performance goals for economic efficiency, management procedures have to be instituted for control of the open period by improved heat detection efficiency and conception rate. Monitoring of reproductive performance is essential for success of these efforts. Timely detection of missed heats, and particularly, unsuccessful services requires constant surveillance in order to reduce the resulting loss of days to absolute minimum. Monitoring has to be a continuous effort in most dairy operations. In beef and dairy herds with planned seasonal breeding it is concentrated around this season.

Realistic appraisal of the role of veterinarians in implementation of management programs for intensive reproductive efficiency recognizes two categories of veterinary input. Hormonal manipulations of postpartum anestrus and estrous cycle as well as establishing of preservice estrous cycle pattern in cows and heifers involve but do not exclusively require input of veterinarians. The extent of involvement is determined by cost effectiveness. The other category includes veterinary services essential for success of programs. Timely diagnosis and therapy of abnormalities delaying normal estrus and conception and timely detection of serviced, nonpregnant animals are essential contributions. The significance of the latter is recognized by producers and non-veterinarians. It has stimulated search for management procedures such as progesterone assays, use of ultrasonic devices, etc., as means for early detection of non-pregnancy. So far, rectal palpation used by experienced veterinarians and properly timed is the only means of detection of nonpregnant animals before or at first expected service, reducing days lost due to long service intervals. Deliberate delays of pregnancy examination beyond 45 days, as advocated, cannot be economically justified. Veterinary services for greatest effectivity must be programmed as an integral part of monitoring reproductive performance.

References

1. Anonymous (1971-1972) Annual Report. A.I. Center, Beit-Dagan, Israel. - 2. Barr, H.L. (1975) Influence of Estrus Detection on Days Open in Dairy Herds. J. Dairy Sci. 58:246. - 3. Burton, C.H., Nelson, T.R. and Richardson, C.W. (1976) Putting the Finger on Cost and Returns in Milk Production. J. Dairy Sci. 59:1200. - 4. Conlin, B.J. (1974) Use of Records in Managing for Good Lactational and Reproductive Performance. J. Dairy Sci. 57:377. - 5. Esslemont, R.J. and Ellis, P.R. (1974) Components of a herd calving interval. Veterinary Record, 95:319. - 6. Esslemont, R.J. (1976) Melbread Herd Health Recording Scheme. IX World Buiatrics Congress, Paris. pp. 847-849. - 7. Foote, R.H. (1975) Estrus Detection and Estrus Detection Aids. J. Dairy Sci. 58:248. - 8. Graves, W.E., Lauderdale, J.W., Riesen, J.W., Saiduddin, S., Casida, L.E., Hauser, E.R. and Tyler, W.J. (1968) Wisconsin Research Bull. 270. - 9. Hansel, W. (1959) The Estrous Cycle in the Cow. Reprod. in Dom. Animals. H.H. Cole and P.T. Cupps, Eds. Acad. Press, N.Y. pp. 239. - 10. Hartman, D.A., Everett, R.W., Slack, S.T. and Warner, R.G. (1974) Calf Mortality. J. Dairy Sci. 57:576. - 11. Hoffman, B., Gunzler, O., Hamburger, R. and Schmidt, W. (1976) Milk Progesterone as a Parameter for Fertility Control in Cattle; Methodological Approaches and Present Status of Application in Germany. Br. Vet. J. 132:469. - 12. Louca, A. and Legates, J.E. (1970) Production Losses in Dairy Cattle Due to Days Open. J. Dairy Sci. 51:573. - 13. Kiplinger Agricultural Letter (1976) Vol. 47, No. 18. The Kiplinger Washington Editors, 1729 H St. N.W., Washington, D.C. 20006. - 14. Milk Marketing Board (1965) Foundation for Progress. Mears Caldwell Hacker Ltd., London, England. - 15. Morris, R.S. (1971) Economic Aspects of Disease Control Programs for Dairy Cattle. Austr. Vet. J. 47:358. - 16. Olds, D. and Cooper, T. (1970) Effect of Postpartum Rest Period in Dairy Cattle on the Occurrence of Breeding Abnormalities and on Calving Intervals. JAVMA 157:92. - 17. Pelissier, C.L. (1972) Herd Breeding Problems and Their Consequences. J. Dairy Sci. 55:385. - 18. Perchner, F. and Lush, J.L. (1959) Genetic and Environmental Portions of the Variation Among Herds in Butterfat Production. J. Dairy Sci. 42:115. - 19. Spalding, R.W., Everett, R.W. and Foote, R.H. (1975) Fertility in New York Artificially Inseminated Holstein Herds in Dairy Herd Improvement. J. Dairy Sci. 58:718. - 20. Speicher, J.A. and Hepp, R.E. (1973) Factors associated with calf mortality in Michigan dairy herds.

JAVMA 162:463. - 21. Spike, P.L. and Meadows, C.E. (1973) Calving Interval Trends in Michigan Dairy Cattle. J. Dairy Sci. 56:669. - 22. Stevenson, J.S. and Britt, J.H. (1977) Detection of Estrus by Three Methods. J. Dairy Sci. 60:1994. - 23. Touchberry, R.W., Rottenstein, W.K. and Andersen, E. (1959) Associations between service interval, interval from first service to conception, number of services per conception and level of butterfat production. J. Dairy Sci. 42:1157. - 24. Warnick, A.C. (1967) In "Factors Affecting Calf Crop." Cunha, T., Warnick, A. and Koger, M. Eds. University of Florida Press. Gainesville, Florida, p. 1. - 25. Warwick, E.J. (1967) In "Factors Affecting Calf Crop." Cunha, T., Warnick, A. and Koger, M. Eds. University of Florida Press, Gainesville, Florida. p. 4. - 26. Whitmore, H.L., Tyler, W.J. and Casida, L.E. (1974) Effects of early postpartum breeding in dairy cattle. J. Animal Sci. 38:339. - 27. Williamson, N.B., Morris, R.S., Blood, D.C. and Cannon, C.M. (1972) A Study of Oestrous Behaviour and Oestrus Detection Methods in a Large Commercial Dairy Herd. I. The Relative Efficiency of Methods of Oestrus Detection. Vet. Rec. 91:50. - 28. Wiltbank, J.N., Ingalls, J.E., Rothlisberger, J.A. and Kasson, C.W. (1967) In "Factors Affecting Calf Crop." Cunha, T., Warnick, A. and Koger, M. Eds. University of Florida Press. Gainesville, Florida. p. 11. - 29. Zeddies, J. (1976) Der Wirtschafliche Wert Der Fruchtbarkeit. 6. Hulsenberger Gesprache Der Schaumann-Stiftung Zur Forderung Der Agrarwissenschaft. - 30. Zemjanis, R., Fahning, M.L. and Schultz, R.H. (1969) Anestrus the practitioner's dilemma. Vet Scope 14:14.