Journal of Reproduction and Infertility 7 (1): 15-23, 2016
ISSN 2079-2166

DOI: 10.5829/idosi.jri.2016.7.1.102139

Review on Various Managemental Aspects Involved in Artifical Insemination and Ameleorative Recommendations for the Benefit of Dairy Producers

Nibret Moges

Clinical Medicine Department, Faculty of Veterinary Medicine,
University of Gondar, P.O. Box 196, Gondar Ethiopia

Abstract: The effect of population increase, in developing countries, subsequently income growth and urbanization now days lead to tremendous growth demand for quality proteins and essential micronutrients that are needed for nutrient balance in marginal diets based on staple grain and root crops. However, the low productivity of the indigenous cattle and current rapid growth of human population, make it difficult to meet the protein requirements of the population. To improve the productivity of the local animals and to offer the increasing demand of milk products at affordable price, increasing dairy production through reproductive technologies like AI service become important. AI is a process by which sperm are collected from the male animal, processed, stored and artificially introduced into the female reproductive tract for the purpose of conception. It is the major option to be effectively utilized. In developing countries, the development and spread of AI programmers has many advantages in permitting the use of good sire to produce many daughters in different agro climate zone to improve the future generation. It also helps in prevention the spreading of venereal diseases through use of disease free bulls and extension programme aimed at improving productivity that can be operated through AI service. However, various factors are known to affect the AI service such as poor care and rearing of males from birth to maturity, ability to detect heat timely, inability to inseminate at the right time, health status of the herd, lack of good network infrastructure and other technical and financial problems, which directly or indirectly influence productivity. To alleviate and improve the existing situation related to the service the government should give more emphasis. On top of that the involvement of non-governmental organizations and private sectors incardination with concerned bodies is vital.

Key words: Artificial insemination (AI) · Bovine semen · Management · Recommendation

INTRODUCTION

Ethiopia has the largest cattle population in Africa with estimated number of 41 million heads [1]. Over 99% of the cattle populations are indigenous breeds. The agricultural sector including livestock in the country is a corner stone of economic in the routine social life. The sector employs 80-85% of the population and contributes 40% of the total GDP [2]. However, the low productivity of the indigenous cattle and current rapid growth of human population, make it difficult to meet the protein requirements of the population to improve the productivity of the local animals.

Accordingly, artificial insemination (AI), which is the first generation of reproductive biotechnology, has been widely used in Ethiopia in dairy production at national level. It started in early 1930 during the Italian occupation. Since then cross breeding using temperate breeds and in digamous has been practiced [3].

Globally, more than 110 million female cattle, accounting for 20% of the total global population of breeding females are inseminated annually. There is still great potential for expansion [4,5]. In Ethiopia various factors have been suggested to affect AI services such as: absence of concrete and binding breeding program, no clearly defined breeding objective [6], no suitable working environment, poor recording performance, no stability in the semen production, limited service to major cities and towns [7]. Moreover, lack of linkage between animal management and breeding, lack of routine field efficiency control, monitoring and evaluation and poor heat detection, semen

Corresponding Author: Nibret Moges, Clinical Medicine Department, Faculty of Veterinary Medicine, University of Gondar, P.O.Box 196, Gondar Ethiopia.

transportation, professional skill, managerial and financial constraints are found to affect AI services. According to the recent study conducted by Dekaba *et al.* [8] lack of reliable supply of breeding stock to sustain production of crossbreeds on farm, declining service of bull stations and AI services, unintended and the use of unknown genotype calves are closely linked to poor AI service. Furthermore trends in genetic change are not being monitored. Under these circumstances, the advantage with cross breed cows cannot be sustained. Cattle in smallholder herds do not necessarily lead to genetic improvement so that AI service is a serious issue requiring great attention [9].

However, timely identification of the cause of inefficiency is important and helps us to rectify the errors and to trace appropriate strategy to improve the service, in coordination with all concerned organization; awareness of the necessity to find suitable solutions in order to resolve the constraint after in depth verification in the AI service delivery [10]. Possible solution are policy backing regarding breeding legalization support within effective implementation; establish suitable and conducive working environment, consolidation of recording performance, regular field efficiency control, monitoring and evaluation, training to stakeholders as well as to the professionals to upgrade or refresh the skill; provide incentives to AI technicians, facilitate adequate financial flow for better implementation and managerial organization are needed [11].

Generally, the use of cross bred cows has a positive effect on the traditional farm, but considering the current level of performance as mentioned earlier and the milk prices it is unlikely that sound economical benefit would be realized from the business: a strong extension effective market outlet and if it is possible in our condition provision of appropriate credit scheme and pricing incentives need to be in place are to exploit the full potential of the improved genotypes [12].

- To review the various management aspects, involved in the AI that the dairy producers need to give serious attention and accordingly forward possible recommendations to alleviate the problem.

Dairy Cattle Breeding in Ethiopia: Most cattle in Ethiopia are of the natural zebu breeds (Bous Indicus), as has been found in most tropical countries and characterized mostly by producing considerably less milk than European breed [3]. The average milk production capacity of the indigenous cow per head per location is estimated at 213 kg which is very low [13].

The introduction of exotic breeds has been suggested as one option to improve the productivity of indigenous cattle, but it has become expensive and risk because the cost of milk production is often greater than the gross income that can be obtained [13]. Therefore, combining the adaptability (disease tolerance, ability to heat tolerance) of indigenous cattle with that of high production performance of temperate cattle through cross breeding has been found to be relevant to increase productivity especially for dairy production. Understanding the existing situation, a lot of efforts have been done in National Artificial Insemination Center. However, the AI coverage (Table 1 and Table 2) figure is very low when compared with the potential number of (5-6 million) breed able cattle that are available in the country.

Table 1: Total inseminations, calves born, pregnancy rate and number of service per conception due to AI Ethiopia

Year	Total Insemination	Calves Born	Pregnancy	NSPC
1984	4860	1852	38.1	Not available
1985	5755	2193	38.1	1.80
1986	11349	4325	38.1	1.60
1987	10861	2139	19.7	1.60
1988	16900	7424	43.9	2.87
1989	19697	7505	38.1	2.48
1990	20695	7888	38.1	2.50
1991	29590	7543	25.5	2.80
1992	16280	6205	38.1	2.40
1993	22026	8395	38.1	2.06
1994	21707	7341	33.8	2.0
1995	26442	7718	29.2	Not available
1996	25824	10984	42.5	Not available
1997	26232	7928	30.2	Not available
1998	32697	10771	32.9	Not available
1999	32999	10401	31.5	Not available
2000	33550	10072	30.0	Not available

NSPC denotes number of services per conception
Source: NAIC[7].

Table 2: AI coverage, semen production and AI application in different parts of the world

	AI Coverage			
Region	% of Cattle Population	Semen production (Straw/year/country)	AI Application	Sources
Africa	<2	57787	30637	369 Chupin and Shuh
Asia	3-12	1314246	377215	543 >>
Latin America	5-6	442987	308127	841 >>
Near East	4.5-14	442987	110675	801 >>
Ethiopia	Not available	35545	20649	312 NAIC

Source: NAIC [13] and Chupin and Shuh[16].

The proportion of improved cattle are far away from the increasing need to sate a service, so that the national AI scheme should adopt a strong and functional organization that can win the farmers confidence and also on the necessity of a well organization that can win the farmers confidence and also on the necessity of a well organized national dairy recording scheme that works in close cooperation with, different government and nongovernmental organizations [7].

Artfical Insemination in Dairy Cattle

General Consideration: Artificial Insemination is a process by which sperm are collected from the male, processed, stored and artificially introduced in to the female reproductive tract for the purpose of conception; AI has become one of the most important techniques ever devised for the genetic improvement of farm animals. It has been most widely used for breeding dairy cattle and has made bulls of high genetic merit available to all [14].

History of AI: In the history of AI, old Arabian documents dated around 1332 A>D> showed that an Arab Chieftain wanted to mate his prize mare to an outstanding stallion owned by the enemy. He introduced a wand of cotton in to the mare's reproductive tract and then used it to sexually excite the stallion and causing him to ejaculate. The semen was introduced in to the mare resulting in conception. Anthony Van Leeuwenhook, inventor of microscope first observed human spermatozoa under magnification. This finding led to further research. Spallanzani is usually considered the inventor of AI. His scientific reports of 1780 indicate successful use of AI in dogs. In 1899, Ivanoff of Russia pioneered AI research in birds, horses, cattle and sheep and has been the first to successfully inseminate cattle artificially. Mass breeding of cows via AI was first accomplished in Russia, where 19800 cows were bred in 1931 and in Denmark has been the first to establish an AI cooperative association in 1936 [14].

AI has been introduced by the Italians in Asmara, the former part of Ethiopia just before the Second World War having been abandoned during the war it was taken up again in 1952 with imported semen, but was discontinued 5 years later for economic reasons. The Asmara service was begun in the late 1960s and continues to operate for some years under the DDE (Dairy Development Enterprise). The present Asmara service was begun in the late 1970s and continued to operate on a small scale using deep-frozen semen from Addis Ababa [3]. An independent service was started in 1967 in Asella to serve the Arsi area under the Swdish International development Agency (SIDA) aided project in Asella in 1972. The present service in the Addis Ababa area started in 1968 under the DDE and served city cows. Although DDE services continue they are directed to state farms only. The AI service was recognized in 1982 under the ministry of Agriculture National Artificial insemination Center [15].

Heat Detection: Errors in heat detection have a substantial effect on the length of the breeding period; conception rates day's open and calving intervals [17, 18]. Two to three times 30 minutes intensive visual observation period per day can enable to achieve high rate of efficiency, visual observation remained as the most practical and economical method in tropical countries. New approaches are being developed to provide automated systems for oestrus detection using electronic technology. The goal of an oestrus detection programme should identify oestrus positively and accurately in all cycling animals and consequently identify animals not cycling. The ultimate goal should be to predict the time of ovulation, thus allowing for insemination that will maximize the opportunity for conception [19, 20].

Timing of Insemination for Maximum Conception: A frequent question concerning AI is the time of oestrus during which cows should be breed for greatest chance of conception, since oestrus may last 10 to 25 hours, there is

considerable latitude in possible time of insemination, much research works have indicated that conception rates is lower when cows are breed prior to mid oestrus or later than 6 hours after cessation of oestrus (standing heat in this case). Success in insemination timing is dependent upon a good heat detection program [21]. It has been recommended by Chupin and Schuh[14] that cows detected to be in heat in the morning should be inseminated in the same day, while those showing heat signs in the afternoon should be inseminated in the morning of the next day for better efficiency.

Factors Affecting the Efficiency of Artificial Insemination: The following four factors have been reported to determine AI efficiency, heat detection skill, fertility level of the herd, semen quality and insemination efficiency; In general, low efficiency levels are reported in developing countries. For AI services the pregnancy rate in Africa has not exceed 45% and the conception rate to first service is 48% in Zebu cows kept at the ministry of agriculture ranch in Ethiopia [22].

Selection of Breeding Bull

Selection for Functional Efficiency: Selection of breeding bulls should consider the capacity of bulls to copulate and to provide semen effectively, libido, courting and mating behavior additional to the semen quality. In general, it is recommended to use younger bulls that achieved puberty and sexual maturity and during selection, breeding soundness examination should be conducted [23].These investigations involve careful examination of the bull, which include morphological verification and semen quality, physical fitness like locomotory system, active accessory glands. In addition, the scrotal circumferences has been recognized to be highly heritable and to serve as an indicator of puberty, total sperm production consequently, failure to select properly for this trait has the potential of decreasing fertility and production of the generation to come [24].Therefore, the scrotal circumference estimates for most young bulls has been recognized to be 32 – 36 cm; the average estimate being 26.1 cm Coulter [23]and 27.9cm Chacko[24] at puberty.

Selection for Productivity: Bull should also be selected for their genetic performance for milk yield information about the genetic potential of bulls for productivity could be obtained either from progeny testing or from Ancestral or relative performance. It is indicated that, selection based on progeny testing requires a long time and a complex recording system to see progeny performance and selection based on pedigree information resulted in faster rate of genetic improvement [26,27]

Management to Breeding Bulls

Housing Breeding Bulls: Breeding bulls should be separately kept from the herd and from each other to protect them from disease transmission and fighting trauma. Mature bulls must be kept in individual runs adjacent to their pens[28]. For mature large breed dairy bulls, the stall should have a minimum surface area of 3.7 meter by 4.3 meter and bulls less than 3 years old generally be housed in cow facilities including tie stalls, box stalls or loose housing [29].

Feeding: Bulls kept for breeding have to get a balanced feed in order to keep its body condition constantly fit for breeding. Over feeding or under feeding are undesirable for breeding causing lean and fatty body conditions, respectively. Although inconsistent, there are reports indicating quantity and quality of feed supplied to breeding bulls affects percentage motility, motility score and sperm concentration [30-32].In addition, severe under nourishment may cause irreversible testicular damage in young bulls and decreased sperm production in mature bulls, while obesity due to excessive feeding can temporarily reduce breeding performance and semen quality and cause laminitis [33, 34]

Health Care: Breeding bulls should be protected from any disease, particularly from venereal disease, which can be transmitted sexually. Principally from those such as vibriosis, trichomoniases, brucellosis, bovine viral diarrhea, are important considerations when using bulls for AI [35-38]. In infection of bovine genital tract there may be impaired sperm transport or sperm death in the bull or embryonic and fetal death after the infection is transmitted to the cow [6].

Breeding Record: Breeding records service to be of benefit to the tropical dairy farmer. It focuses on the production traits that are important. The reasons and need for the seeing breeding goals based on biological efficiency and local production system. When using available recording in a national data base records must be up –to-date and easily accessible. They should be kept in a dry and place within the diary shed in a position, which the small holder passes each day and can easily stop to update records [39]. Breeding records should include: Name of sire and dam, heat dates and comment,

calving date and comment, earliest breeding date, service information, pregnancy examination, expected calving date, drying of date, any additional remarks [40]. Furthermore it is important to give good feedback from the recording outcomes to the farmers, so that they can see the benefits of it and thus become more motivated [41]. This could be explained by a grater inseminator's adaptation to their working environment, combined to the progressive elimination of farms with poor dairy cattle reproduction management. This trend must be confirmed by routine filed survey results [42, 43].

Fertility Assessments: Fertility assessment refers to repeated and regular examination of bulls for libido, serving capacity morphological soundness and semen quality. Libido is defined as sexual desire while serving capacity is the availability to complete the act of copulation, both these characteristics differ among bulls and are distinctly different components of fertility there are reports in dictating that libido and serving capacity are influenced by genetic, heritage and vary among sires of the same breed. Unfortunately libido and serving capacity do not correlate well to other fertility parameters bulls may pose quality semen, but may be unacceptable breeders because of lack of desire or mating ability [44]. In addition a bull should be examined [44,45,46] annually in all breeding age bulls which include: Visual assessment, eyes, teeth, foot legs and external genitals; Internal palpation of accessory sex glands, ampullae, vas deferens, vascular glands, prostate glands, pelvic urethra; Electro ejaculation of semen sample collection; Sperm evaluation, including volume, color, PH and concentration, motility (individual motility, mass motility); Scrotal symmetry position skin (Thin, soft and non fused) and measurement; physical exposure and examination of genitalia [47].

Semen Collection: Semen can be collected by using different methods including artificial Vagina (AV) [42] electro ejaculator and by physical massage of the ampullae and vesicular glands through rectum[14]. AV is simple in construction and it stimulates natural copulation by providing suitable temperature, pressure and lubrication that evoke ejaculation and yield representative sample [28].The AV consists of a farm cylindrical tube with a thin – walled rubber lining. The jacket formed is filled with warm water. A rubber funnel connected a collection receptacle is attached to one end of the cylinder. When the Jacket is properly filled and the AV lubricated and properly applied, this method of semen collection is highly successful [14]. The other techniques that have been applied less frequently for semen collection are the electro ejaculator and manual manipulation. Electro ejaculator is used when the bull refuses to serve the AV or when it fails to mount and the quality of semen obtained by electro ejaculator and manipulation of ampullae and vesicular glands is relatively poor [33,14, 28]. In AI center semen are typically collected 2 or 3 times per week per bull, with 2 or 3 ejaculations per collection day. An experienced veterinarian or reproductive physiologist should determine semen quality. An examination of the reproductive tract may indicate possible abnormalities in semen quality [48- 50].

Semen Evaluation: Semen evaluation has great diagnostic value in determining the cause, severity and degree of testicular and the accessory gland pathology or infertility, as well as being of value in estimating the fertility of the male. The most important parameters to be used for semen evaluation as suggested earlier [14, 28, 51, 52] are: volume, concentration; total sperm per ejaculate progressive motility and morphological abnormality.

Semen Processing and Storage: The semen ejaculated and collected should be diluted or extended before freezing and storage. The main reason for extending or diluting or semen is to increase the number of females serviced from one ejaculation. A normal ejaculate from a dairy bull contains 5 to 10 million sperm, which can be used to inseminate 300 to 1000 cows if fully extended. There are several good semen extenders. Those made from egg yolk or pasteurized; homogenized milk are two of the most widely used and recently that addition of glycerol to the semen extender improved resistance of sperm to freezing penicillin and streptomycin are also added to semen to inhibit bacterial growth and reduce danger of spreading diseases such as vibriosis [14,28].

Factor Affecting Bovine Semen Quality

Age: Indigenous (Zebu) cattle in general have been recognized to reach puberty 6 – 12 months later than the exotic breeds [52]. Age at first breeding has been found to depend more on body weight than on age and can be delayed by slow growth [28]. Similarly, it has been reported that the testicular size, scrotal circumference and body weight are positively correlated with age and the semen volume. Quality and amount of mature spermatozoa have also been found to be positively correlated with testicular size and scrotal circumference [3,53, 54].

If every parameter has been kept equal, best semen quality has been obtained from bulls, which are a little under weight. Brito *et al.* [49] have assessed the effect of environmental factors, age and genotype on sperm production and semen quality in AI bulls in Brazil and found an increase sperm minor defects and decrease in sperm motility with an increase in bulls' age. Breed: Libido are sex drive and mating ability in the bull has been reported to be influenced by genetic factor and lack of sexual desire has been found more common in some strains and beef breeds and Bosindicus than others [28]. However, no association has been observed between libido and quality.

Nutrition: the importance of proper nutrition (adequate amount of vitamins and minerals, balanced amount of protein and energy) for good reproductive performance of has been known. Balanced amount of protein and energy are required for production and physical activity associated with breeding. Nutritional deficiencies in the bull have been reported to delay the onset to puberty and depress production and characteristics of semen. The negative effect of under feeding has been found to be more serious in young than adult bulls [28].

Temperature and Season: Climatic factors like ambient temperature, humidity, convection current and solar radiation affect testicular function directly or through neuro hormonal mechanism [54]. Elevated body temperature during periods of high ambient temperature or pyrexia from disease has been noted to cause testicular degeneration and reduce the percentage of normal and fertile spermatozoa in the ejaculate [28]. Higher semen volume from August to December and higher sperm abnormality during June and July in Pakistan livestock research station on cross breed Friesian and Shiwal are observed to affect fertility due to thermal stress [19].

Diseases of Testis, Epididymis and Accessory Glands: Pathologic condition of testis, epidydims and seminal vesicle has been recognized to interfere with fertility by disturbing spermatogenesis or sperm maturation leading to abnormal semen characteristics or preventing passage of spermatozoa from testes to urethra [28,38, 53]. Some of such disease conditions include testicular degeneration, orchitis, epididmitis and seminal vesiculaitis.

Preganancy Diagonosis: Early pregnancy diagnosis is a key to successful breeding programme and is of fundamental in the control of infertility in the farm animals. Choice of a method to diagnose pregnancy depends on the stage of gestation. Various methods rectal palpation, ultrasound, Enzyme Linked Immuno Sorbent Assay (ELISA) and progesterone tests employed for the pregnancy diagnosis in farm animals [16,29,35, 51]. Per rectal examination of the genital tract is the cheapest and most accepted of pregnancy diagnosis. It has the advantage of being accurate, fast, less labor intensive. Nonetheless training is necessary and the examination should be conducted by veterinarian or by an experienced herdsman. Some experienced veterinarians are able to determine pregnancy by palpation as early as 35 days after insemination. But usually rectal examination takes place between 45 and 60 days after insemination [17,26]. Application of trans rectal real time Ultrasonography is used for routine reproductive examination of dairy cattle. For assessment of pregnancy status and fetal viability early post breeding to identify cows that fail to conceive, improves reproductive efficiency by decreasing the interval between artificial insemination services and increasing artificial insemination services rate [25]. The use of on-farm enzyme linked immune sorbent assay (ELISA) progesterone test as an aid in the early detection of pregnancy is important (Primordial pregnancy diagnosis) the ability of the plasma progesterone test to predict early pregnancy diagnosis 21 days after breeding is accurate [18]. Progesterone can be detected in milk, plasma on day 20 – 24 after mating as indicator of pregnancy [46].

CONCLUSION

In this piece of review some aspects of AI and its general consideration to improve dairy production has been revised and noted, the efficiency of AI service is mainly depends on various factors including the ability to detect heat timely, ability to inseminate at the optimum time, fertility status of the herd, technician efficiency poor breeding record practice and other farm managerial and financial problems.

In light of the above conclusions the following recommendations are forwarded:

- Training should be provided to the staff (short term refreshment course) and the farmers to upgrade and update them with the AI technologies.
- Establishing incentive mechanisms, to stimulate morally and financially to those participate in the breeding activity.

- Adequate recording system should be practiced.
- Enhance the participation of private sectors in the AI program and build up the regional capacity in the establishment of it is own AI center.

ACKNOWLEDGEMENT

I would like to express my gratitude to University of Gondar, for its overall support in writing this review article.

REFERENCES

1. CSA., 2004. Ethiopian Livestock Estimates. Central Statistics Authority (CSA), Addis Ababa, Ethiopia.
2. Sileshi, Z., A. Tsegahun and Tegene, 2001. Status of livestock Research and Developmnet in Highlands of Ethiopia In: Wheat and Weeds: Food and Feed. Proceedings of two Stakeholders' workshops. Addis Ababa (Ethiopia), 10-11 Oct.2000, pp: 227-250.
3. Heinonen, M., 1989. Artificial Insemination of Cattle in Ethiopia, Ministry of Agriculture, pp: 21-103.
4. Falvey, L. and C. ChantalaKhana, 1999. Smallholder Dairying in the Tropics. ILRI (International Livestock Research Institute), Nairobi, Kenya, pp: 462.
5. Thibier, M., P. Humblotand B. Guerin, 2004. Role of reproductive biotechnologies In: global Perspective, current methods and success rates. Simm, G. ed. Edinburgh (UK), pp: 171-189.
6. Belihu, K., 2002. Analysis of Dairy Cattle Breeding Practices in Selected Areas of Ethiopia, PhD Thesis, Humboldt University of Berlin, Department of Animal Breeding In the Tropics and Subtropics, Berlin, Germany.
7. NAIC., 1995. NAIC at a Glance Ministry of Agriculture, National Artifical Insemination Center, Addis Ababa, Ethiopia.
8. Dekaba, A., W. Ayalew and B.P. Hegde, 2004. Observations on the performance of cross breed Dairy Cattle in Smaiiholder Herds in Degem District Ethiopia. In: Farm Animal Biodiversity in Ethiopia Status And prospects. Proceedings of the 11th annual Conference Of the Ethiopian Society of Animal production 28 – 30 Aug 2003 Addis Ababa, Ethiopia.
9. Shiferaw, T., M. Shiberu and T. Cherinet, 2002. Experience on field of AI management in Ethiopia. In: Livestock in food Security-roles and contributions proceedings of the 9thannual conference of the Ethiopian society of animal production (ESAP). Addis Ababa (Ethiopia), 30-31 August 2001, pp: 323-335.
10. Kumsa, T., 2002. On Farm Use of Multipurpose F1 Crossbred Cows in the Mixed Crop Livestock Highland Production system in Ethiopia. PhD Thesis. Royal Veterinary and Agricultural Univ., Fredericksburg (Denmark). Dept. of Animal Science and Animal Health, pp: 225.
11. Tegegen, A. and G. Alemu, 1997. Prospects for peri Urban dairy Development in Ethiopia. In Proceedings of the fifth national Conference of the Ethiopia Society of Animal Production. 15-17 May 1997, Addis Ababa, Ethiopia, pp: 28-39.
12. Webb, D.W., 1992. Artificial insemination in Dairy Cattle: Dairy Science, Department Institute Of Food and Agricultural Sciences, University of Glorida, Gainesville.
13. NAIC., 1995. Short Description on the Activity of National Artificial Insemination Center. A Brochure.
14. Chupin, D. and H. Schuh, 1992. Survey of present Status of the Use of Artificial Insemination in Development Countries. Animal production Health Division, FAO, Rome, Italy.
15. Morrow, 1986. Diagnosis, Tretment and prevention of Reproductive Diseases in small and LargeAnimals. In: Current therapy in Theriogenology. S.B. Sanders Company, Philadelphia.
16. Mathvron, M., M. Dekkers and C.M. Jackson, 1998. Environmental, Managemnet and Genetic Factors Affecting Semen production in Holstein Bulls, J. Dairy Sci., 81: 3321-3330.
17. Nebel, R.L., M.G. Dranasfield, S.M. Jobst and J.H. Bame, 2000. Automated electronic Systems for the Detection of Oestrus and Timing of AI in Cattle. In: Animal Reproduction. II research and practive. Proceedings of the 14<suo (tb)> International Congress. Stockholm (Sweden), 2-6 Jul 2000 Forsberg N., 60/61: 713-723.
18. Peralta, O.A. and R.L. Nebel, 2004. Heat Detection: The Latest In: Large Animal. Proceedings of the North American Veterinary Conference, 18: 49-51.
19. Bee Man, K., 1999. Artificial Insemination Basics. Department of Clinical Sciences College of Veterinary Medicine Kansas State University 96 TLBAA Breeders Hand Book, pp: 15.
20. Mukasa-Mugerwa, E., 1989. A review of the Reproductive performance of Female Bosindicus (Zebu) Cattle. Monograph No.6 ILCA, Addis Ababa, Ethiopia, pp: 59-73.

21. Risco, C.A., 2002. Management and economics of Natural service sires on Dairy Herds; Department of Large animal Clinical Sciences, College of Veterinary Medicine, University of Florida, Granesville, Florida USA, Published by International Veterinary Information Service, pp: 145-167.
22. Ott, R.S., 1981. Breeding Soundness Examination of Bulls. In: Current Therapy in Theriogenology 2nd Philadelphia, W.B Soundnes Company, pp: 125-723.
23. Coulter, G.H., 1986. Puberty and Pubertal Development of Bee Bulls. In: Current Therapy in Theriogenogy. 2nd ed. Philadephia: W. Sounders Company, pp: 142-152.
24. Chacko, C.T., 1994. Development of the Sunandini cattle in India, world Animal Review, 80/81: 3-4.
25. Systad, O. and J. Ruane, 1998. Prospects and Strategies for Genetic important of the Dairy Potential of Tropical Cattle by Selection. Center for International Environment and Development Studies, the Agricultural University of Norwat, Norway.
26. Hafez, E.S.E., 1993. Reproduction in farm Animals, 6th ed. Philadelphia, pp: 405-461.
27. Marlinkowski, D., 2004. Heat Detection problems Evaluation and Solutions. In: proceedings of the Western Reginal Large Herd Management Conference University of Maine Cooperative Extension.
28. Tegegen, A., D. Yifat, K. Tesfu and R. Frances Hini, 1994. Effect of plane of nutrition and seasonal on body and testicular growth and on semen characteristics in Boron and Boran x Friesian Bulls in Ethiopia, J. Anim. Repro. Sci., 36: 197-209.
29. Tozser, J., N. Mezes, J. Varszegi and F. Szasz, 2000. Evaluation of Seasonal effects on the quantitative and qualitative parameter of Ejaculate of the Holstein- Friesian Breeding Bulls Using Sperm Analyzer, Magyar Allatrovosoklapja, 22: 533-537.
30. Arthur, G., D. Noakes and H. Pearson, 1989. Veterinary Reproduction and Obstetrics. 6thed. Bailliere Tindal, London, UK, pp: 14-21 and 567-568.
31. Sprot, L.R., B.B. Crpenter and T.A. Thrift, 1997. Bull Management for Cow/Calf Producers. Texas Agricultural Extension Service. The Texas A and M University System.
32. Aiello, S.E. and A. Mays, 1998. The Merck Veterinary Manual, 8th ed. Merck and Co., White House Station, N., USA, pp: 998-1027.
33. Velic, R., B. Dukic and T. Bajrovic, 1999. Possibility of Infective Disease Transmission by Artificial Insemination Veterinarian (Sarajevo), 48: 125-132.
34. Radostitis, O.M., C. Gay, D.C. Blood and K.W. Hincheliff, 2000. A Text Book of the disease of Cattle, Sheep, pigs, Goats and Horses, 9th ed. W.B Sounders Harcourt Publishers Ltd. Harcourt Place. 32 James town road, London, pp: 867-1087.
35. Vander, W.J. and T. Rust, 2004. Advance in Using Recorded Data to Address Breeding Objectives in Beef Cattle Breeding. In: Performance Recording of Animals State of the Art 2004. Proceedings of the 34th Biennial Session of ICAR 28 may – 3rd Jun 2004 Wageningen (Netherlands), pp: 153-156.
36. Falvey, L. and C. Chantala Khana, 1999. Smallholder Dairying in the Tropics. ILRI (International Livestock Research Institute), Nairobi, Kenya, pp: 462.
37. Bertilsson, L. and S. Jokinen, 2003. Observation of the National Artificial Insemination Center (NAIC). Kaliti, Ethiopia. Minor Field Studies–International Office, Swedish University of Agricultural Science, 239: 9.
38. Srairi, M. and Y. Farit, 2001. Studies on Diary Cattle Reproduction performances in Morocco Based on Analysis of Artificial Insemination Data. Tropicaltura Belgium, 19: 151-155.
39. Wick ham, B.W., 2004. Establishing a Shared Cattle Breeding Data Base: Recent Experience in Ireland. In: Performance Recording of Animals: State of the Art 2004. Proceedings of the 34thBinnial Session of ICaR. Tunisia 28 may-3rd Jun 2004, pp: 339-342.
40. Jensen, W., 1997. Pneumonia of Beef Cattle, Central Coast Agricultural Highlights Newsletter, Decemmer 1997 Issue.
41. Wattiaux, M.A., 1998. Reproduction and Genetic Selection; Babcock Institute for International Dairy Research and Development.
42. Roberts, S.I., 1986. Veterinary Obstetrics and Genital Diseases. 2nd ed. Lithographed by Edwards Brothers Inc. Ann Arbor, Michigan, pp: 60-86 and 500-505.
43. Sorensen, A.M., 1979. Animal Reproduction Principles and practices, McGrow-Hill New York, pp: 292-330.
44. Dee Whittier, W., 2000. Predicting Bull Fertility, Extension Veterinarian, Cattle Department of Large Animal Clinical Sciences, Virginia and Maryland, Regional college of veterinary Medicine.
45. Rouge, M., 2002. Over View of Semen Handling and Analysis Htmhttp: //arb/arb/.CvMbs.Colostate.edu/ hboos/path/ohys/reprod/semenval/motility.htm'.
46. Sane, C.R., S.N. Lutuke and B.R. Deshpande, 1982. A Text Book of reproduction in farm Animals Bombay: Vargheese Publishing House, pp: 425 488, 494-504.

47. Coulter, G.H. and R.H. Foote, 1979. Bovine Testicular Measurements as Indicator of Reproductive Traits in Cattle. Theriogenlogy, 11: 297-311.
48. Sane, C.R., S.N. Lutuke and B.R. Deshpande, 1982. A Text Book of reproduction in farm Animals Bombay: Vargheese Publishing House, pp: 425 488, 494-504.
49. Brito, L.F., A.E. Silva, L.H. Rodriguez, F.V. Vieira, L.A. Dragon and J.P. Kastelic, 2002. Effect of Environmental factors, Age and Genotype on Sperm production and Semen Quality in Bosindicus and BousFuras in Brazil. J. Anim. Repr. Sci., 70: 181-190.
50. Andrabi, S.M., S. Nabeed, L.A. Khan and N. Ullah, 2002. Semen Characteristics of Crossbreed (Freiesian x Shaiwal) bulls at livestock station, agricultural research center Islamabad Pakistan Vet. J., 22: 181-187.
51. Valdez, C.A., R.C. Zamora, A. Rayous and D.B. Marcial, 2001. Early pregnancy diagnosis in Local Hostein-Sihiwar Cross Bred Dairy Cattle Using Enzyme-linked Immunosorbent Assay Progesterone Test. J. Vet. Med, 38: 38-34.
52. Fricke, P.M., 2002. Scanning the future Ultrasonography as a Reproductive Management Toolfor Dairy Cattle. J. Dairy Sci., 85: 1918-1926.
53. Fredrico, M. and P.J. Hansen, 2003. Pregnancy Diagnosis in the cow. Dept. of Animal Sciences, University of Florida.
54. Wain, N.A., A.K. Mustafa and S.N. Maurya, 2003. Pregnancy Diagnosis in Farm animals Review. Indian J. Dairy Sci., 56: 1-8.