BUFFALO REPRODUCTION IN INDIA: AN OVERVIEW

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INTRODUCTION

The buffalo is backbone of the farmer's economy of India, South-Asia and several European and American countries, benefiting nearly half of humanity in over 40 countries. The Asian countries are producing over 96 % of 48 million tons of the world's total buffalo milk output at an annual growth rate of 4 % (Sasaki, 1997). Buffaloes contribute more than one-third of total milk production in Asia and are the second largest producer of milk in the world. Buffaloes are also valued for meat and draught purposes (Bandyopadhyay *et al.*, 2003).

The world buffalo population is estimated to be 166.4 millions spread in some 129 countries around the world (FAO 2002); 161.4 million buffaloes are found in Asia (97.2%), 3.55 millions in Africa (2.13%), 1.4 millions in South America, and 0.257 million in Europe (0.154%). India has over 93.13 million, or approximately 56.6% of the total world buffalo population (FAO, 2001).

Since 1981-82, the number of buffaloes has increased by a total of 38.8 million which is a 30.4% increase. Interest in water-buffalo breeding is growing in several countries where here to fore the buffalo has been neglected and even unknown, especially in South-America and in Europe.

River-buffaloes are concentrated mainly in South-Asian countries like India and Pakistan. They are reared mainly for milk production with meat as an adjunct. Buffalo bulls are important source of draught power. Buffalo meat is of good dietary value; it is lean and contains less saturated fat compared to beef and pork. In India, buffalo contributes 34.7% of total meat production (Murphy and Prince Davadaso 2003). Presently, the buffalo contributes 1.41 million metric tons of meat to the meat pool of India, which comes out to be 45.74% of global buffalo meat. (FAO, 2000).

The buffalo is a difficult breeder because of its inherent susceptibility to environmental stress, which causes anoetrus and sub-estrus. These two conditions are responsible for a prolonged intercalving period resulting in great economic losses for the dairy industry. The productive and reproductive efficiency of animals are complementary to each other. Low reproductive efficiency in general and in the buffalo in particular remains a major economic problem globally and its incidence is higher in our country. The main interest of the animal breeder is to achieve more young ones in a lifetime, reduced mortality, and healthy and superior young ones. To achieve this goal, normal reproductive tools to augment reproductive efficiency (fertility), means to overcome reproductive constraints, and remedies are needed. The present article reviews reproduction in buffaloes and different approaches to augment reproduction.

Normal Reproduction in Buffaloes:

The age of puberty in buffalo is 36 to 42 months in India. It is somewhat late as compared to other countries like Italy, where the age at first calving is 36 months on average (Borghese *et al.*, 2003). The estrus cycle length is 21 days with a heat duration of 12-24 h. The ideal buffalo produces a calf every 13 to 14 months.

The factor which most strongly influences age at puberty is nutrition level. Buffalo exhibit seasonablity in reproductive activity. The reproductive cycle of buffalo is as follows (Bhikane and Kawitkar, 2000)

- Age of puberty: 36-42 months
- Length of estrous cycle: 21 days.
- Duration of heat: 12-24 h.
- Time of ovulation: 10-14 h after end of estrous.
- Period of maximum fertility: Last 8 h of estrous.

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- Gestation period: 310 days.
- Period of involution of uterus: 25-35 days.
- Breeding season: September to February.

Breeding systems in buffaloes:

Natural mating: Generally in dairy buffaloes, natural mating is used. In certain states, better awareness the buffalo bull and of the dam's milk yield are used in breeding. But for the most part there is no consideration of pedigree and any potent entire male available at estrous is used for breeding. This practice has cause a great deterioration in performance of the buffalo and the destruction of breed characteristics.

Artificial Insemination: Both fresh and short-duration stored extended liquid semen as well as frozen semen is being used for insemination of buffaloes. This service is provided on nominal payment by state department of veterinary medicine and animal husbandry and other agencies like BAIF and NDDB. The network project on buffalo development of ICAR is arranges breeding with the use of frozen semen of known pedigree; Murrah, Nili-Ravi, Surti, Bhadwari, Pandharpuri and the swamp buffaloes of Assam are included in this programme at present (Pathak, 2003).

Although the density of good breeds of dairy type river-buffaloes is greater in the hot and hot-humid parts of tropical India, the problem of low fertility in summer is also more serious. Some of the main reproductive problems of economic importance are:

1. Delayed maturity: Delayed maturity in both male and female buffaloes is common throughout India. This is due to neglect of calves during there growing period. Buffaloes have potential to gain at rates of 400-800 gm daily after about 4-6 months of age and can attain 300-450 kg body weight suitable for breeding at about 24 months of age. But in the majority of dairy buffaloes calving occurs at 4-6 years of age. This is due to an inadequate supply of feed and nutrients during the growing phase (Ranjhan and Pathak, 1992).

2. High incidence of silent estrous and short duration estrous: This is more serious problem during the hot and humid-hot months. Due to these reasons, heat is often missed, and tethered females or females grazing with outpotent males in the herd remain unbred. This is an important factors contributing to the long intercalving period.

3. Non-availability of proven sires and good quality semen of proven buffalo-bulls.

4. Occurrence of venereal diseases causing infertility and sterility: These problems are encountered in both sexes, and the cause of there spread is the use of bulls for natural service. In recent years these problems have shown an increasing pattern because of increased use of artificial insemination in remote villages with the help of improperly trained inseminators. In some places, such persons present themselves as veterinary doctors though they have no education clinical training. These persons may cause severe damage to livestock health and the wealth of the country. (Pathak, 2003)

5. Poor heat sign: Silent heat in the buffalo is one of the most important unsolved impediments to efficient breeding. It occurs in the hot seasons. A combination of estrus detection methods may be necessary for identification of animals in heat. (Remesh *et al.,* 2002).

6. Anoestrum: Post-partum anoestrus in some buffaloes that have calved during cool season, i.e. the normal breeding season, have a shorter post-partum estrus interval than those that calve during last breeding season (February through July).

7. Poor nutrition: Adequate nutrition is prerequisite for proper functioning of the reproductive system in animals. Underfeeding, overfeeding; protein and vitamin deficiency, and imbalance of trace elements results in various reproductive abnormalities. A poor body condition score at calving adversely affects fertility, characterized by prolonged post-partum intervals, reduced conception rates, and more services per conception. A very low protein diet can cause cessation of estrus. (Agrawal *et al.*, 2003).

Approaches for improving reproductive efficiency:

During the last two decades, farm animal reproduction has entered into the area of a new biotechnology revolution which includes artificial insemination; induction and synchronization of estrus (manipulation of breeding cycle); super ovulation embryo transfer; cryopreservation; embryo resource development; sexing; transgenesis; cloning chimera production; and early pregnancy diagnosis. Some of these technologies have immense

potential to revolutionize world animal agriculture in the twenty-first century.

Artificial insemination: One effective ways of rapidly accelerating significant genetic improvement is A.I., but A.I. is not successfully practiced in buffalo because

1. Difficulties in estrous detection.
2. Difficulties in semen preservation.
3. Lack of certified semen programmes.

Reproductive performance of buffaloes:

Reproductive efficiency is determined by many different processes, which result from interaction among genetic and environmental factors. The processes involved singly or in concert, include age of puberty/maturity, pattern of estrous cycle and estrous behaviour, length of breeding, ovulation rate/ litter size, lactational anoestrous period, post-partum anoestrus intercalving period, and reproductive life span. These traits combined measure breeding efficiency/performance (Agrawal, 2003).

The reproductive effciency in buffalo is so alarmingly low that it poses a very serious threat of economic loss to Indian and animal husbandry professionals (Ramesh *et al.*, 2002). In such a scenario, an ample scope exists for increasing the reproductive efficiency by modification in the traditional methods of breeding, feeding, management and disease control.

Reasons for poor reproductive performance:

1. Effect of climate: A determining factor in production and reproduction of farm animals all over the world is environment. Season affects the breeding efficiency in the case of buffaloes. There is a tendency to have better performance during the cool months; 70-80% of conceptions in buffaloes occurs between July and February. Buffaloes are sexually activated by decreased day length and temperature. A lower number of services per conception are needed during the July-February breeding season than the March-June breeding season (Agrawal *et al.*, 2003).

2. Poor thermal tolerance: Buffaloes have poorly developed thermal regulation system. During the summer they have to be protected from the extreme heat by allowing them wallowing; also in winter, they have to be protected from extreme cold, which may predispose them to many diseases. (Ramesh *et al.*, 2002).

One of greatest source of failure in A. I. is the inability to recognize estrous display. With frozen semen, the need to inseminate close to ovulation is even more imperative because of the limited survival of spermatozoa. It is possible to extend the life of spermatozoa and package them in such a way as to retain them in the reproductive tract in a viable state for several days. Efforts are being made for micro-incapsulation of spermatozoa, which will help in survival of spermatozoa.

There is an urgent need to start registration of all A.I. bulls by a national society or an all India animal breeder association and to initiate a certified semen programme. Strengthening practical training in animal reproduction for veterinary students and better training of inseminators is also essential. (Agrawal *et al.*, 2003).

1. Insemination should be done during the latter half of the period of heat.

2. In heifers, the first heat should be avoid to make the animal more receptive.

3. Buffalo should be calm and quiet at time of insemination

4. The Best site for insemination is the mid cervix and the body of the uterus (Ramesh *et al.*, 2002).

2. Induction and synchronization of estrous:

Controlling the estrous cycle and regularizing it. A. I. would provide a means for circumventing the problem of estrous detection. For a satisfactory pregnancy rate in an embryo transfer programme, the embryo must be placed in an environment that simulates the one from which it was removed. So

synchronization of estrous in the donor and recipient in each experiment is considered essential to obtain the best result.

Induction and synchronization of estrous can be achieved by two alternate approaches. The first is by artificially extending the luteal phase (by using progestatimal compound) and second by inducing device of the corpus luteum (by using prostaglandins and analogues.).

Progestogens with some possible adjustment in PMSG and or FSH are used for anticipated lower response. Presently $PGF_2\alpha$ is widely used to manipulate the early breeding of post-partum buffaloes and pubertal heifers. It is also used in a double dose schedule (10-11 days interval) for those animals, which do not have functional CL at the first injection. (Agrawal *et al.,* 2003).

3. Superovulation (multiple ovulation): Superovulation is one of the major reproductive technologies for rapid genetic improvement of livestock. (Agrawal *et al.,* 2003).

4. Reduction of unproductive period: Method of reducing the interval from calving to conception and decreasing no. of services per conception. (Ramesh *et al.,* 2002).

Oral Prostagen (Chlormadinone acetate, melangestrol acetate) for a 14-day period, starting on the 21st day after calving was found to be effective in reducing interval between parturition and conception.

Short-term progesterone (PRID/ CIDR) and progestagen (ear implant) for 7-10 days also stimulates breeding activity regardless of whether the animal is cyclic or anoestrous. FSH in conjugation with progesterone enhanced the follicular development in the post-partum period. Progesterone plus estradiol treatment resulted in synchronized wave emergence with normal luteal activity in post-partum anoestrous animals. (Ramesh *et al*. 2002).

5. Embryo transfer technique: The embryo transfer technique permits exploitation of superior female genotype, giving more off-spring from the same genetic donor than would arise under normal conditions of breeding. Embryo technologies are also used to resolve several reproductive enigmas, viz. uterine sufficiency; maternal reorganization of pregnancy; embryo-utero-relationship. (Agrawal *et al.,* 2003).

6. Heat detection technique: Wall charts, breeding wheels, herd monitors and individual buffalo records are estrous detection aids. These systems are the least expensive. The key to successful use of these management aids is accurate recording of every heat beginning with the first after calving and their daily use to identify those buffaloes that are due to return to estrus. (Ramesh *et al.,* 2002).

A. Mount detection involves two methods:

1. Pressure sensitive devices
2. Paint stick or paint on tail head. (Ramesh *et al.,* 2002).

B. Heat detector animals:

Sexually active animals are used to detect buffalo in heat. They are fitted with chin ball markers. (Ramesh *et al.,* 2002)

C. Use of dogs:

Dogs can be trained to detect odour associated with estrus in buffalo.

D. Use of milk progesterone assay:

With the help of RIA, milk progesterone concentration can be determined. Progesterone level of < 200 pg/ml indicates an animal is in estrus.

E. Use of pedometry

7. *In-vitro* fertilization: *In-vitro* fertilization is also most important tool to increase the reproductive performance/efficiency in buffalo. Addition of heparin and caffeine in the medium used in *in-vitro* fertilization system helps in inducing capacitation and acrosome reaction in buffalo spermatozoa. (Agrawal *et al.,* 2003).

8. Enzyme immunoassay: Measurement of progesterone and to a lesser extent, of estrone sulphate has found practical application as a method of improving reproduction in farm animals. For instance, diagnosis of (non) pregnancy and confirmation of (non) estrus is possible on the basis of progesterone concentration in body fluids. Progesterone determination in plasma or milk can serve as valuable diagnostic tools in buffaloes for accurate estrus confirmation and hence correct timing of A.I. and diagnosis of pregnancy and nonpregnancy 20-24 days post A.I. and also for identifying cystic ovarian disorders. (Prakash, 2003).

9. Use of Biostimulation: Biostimulation may be described as the effect of the male on estrus and ovulation through genital stimulation and priming pheromones. Biostimulation plays important role in reproduction such as hastening sexual maturity, induction of ovulation, and reduction of post-partum anoestrus.

Biostimulation modulates the following reproductive activities, and it has been used for augmenting the reproductive efficiency in recent years.

1. Induction and synchronization of estrus.
2. Age at onset of puberty.
3. Postpartum estrus.
4. Silent heat.
5. Ovulation rate (Khub Singh, 2003).

Managemental Issues:

Three main constraints important in management of buffaloes are:

1. Summer stress
2. Winter stress at high altitude
3. Inadequate quantity of non-polluted, wholesome water for drinking and wallowing (Pathak *et al.,* 2003).

1. Summer management:

- Keep buffaloes in airy, cool and comfortable place. Keep animals under shady trees and sprinkle water on their surroundings.
- Provide fresh and cold drinking water.
- Supply fresh green fodder.
- Make provision for night feeding.
- Grazing should be done only on green pasture in morning and evening hours.
- Mineral mixture and salt should be supplied daily.
- A deworming schedule should be followed with spraying for ectoparasites.
- Avoid overcrowding.
- Sheds should be properly ventilated. (Ramesh *et al.,* 2002).

2. Winter management:

- Protect buffaloes from extreme cold.
- Provide proper bedding to the animals.
- Increase sources of energy for breeding stock through high-energy diets.

Maintenance of hygienic conditions on buffalo farms and in dairy buffalo stalls is less expensive. Health problems of buffalo may be widespread or localized (Pathak and Sharma, 1988). Provision of a dry place for resting, timely disposal of dung and urine, dairly washing/wallowing, sprinkling of phenyl lotion on water, occasional application of flaked lime power and use of gunny bag soaked in saturated solution of washing soda at entrance particularly during the spread of viral disease like F.M.D. are considered useful in providing reasonably satisfactory protection against many diseases. (Ramesh *et al.,* 2002)

Managemental practices for better reproductive efficiency:

- Proper heat detection.
- Maintaince of accurate record of heat.
- Routine checking of adult females for heat.
- Treatment of the females with abnormal uterine discharge during estrus.
- Checking female for pregnancy diagnosis after 45-60 days of natural service.
- Isolation of the diseased animals from the

healthy herd.

- Following the vaccination programme.
- Provision of balanced nutrition.
- Good housing systems. (Ramesh *et al.*, 2002).

SUMMARY

The major problems of reproduction, their causes and the use of newer technologies along with the new drugs are listed in this article. There is need to understand basic mechanisms of reproductive physiology in buffaloes and the interaction of these mechanisms in relation to season, nutrition, management and breeding technique, economics and social factors together along with use of new drugs. This will certainly help to evolve packages of practices that will help to improve reproductive efficiency and in turn milk production in buffaloes.

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Buffalo in India contributes about 30% of total meat production in the country. However despite this potential and growth, the sector is not well integrated. The present system of production and marketing of buffalo meat for domestic and export market is endowed with multifarious challenges and needs corrective measures at various levels.Â This report provides an overview of the value chain of two production models: municipal slaughterhouse system for domestic consumption and large-scale production for export. Overview of Indian Buffalo Meat Value Chain | 122. 2 Executive Summary. 02 Executive Summary. Controlled Reproduction in Cattle and Buffaloes. 1st ed. CAB Int., Wallingford, UK.Â Peripartum reproductive disorders in buffaloesâ€"An overview.. Vet Scan. 2009; 4: 1-10.Â Genetic analysis of river, swamp and hybrid buffaloes of north-east India throw new light on phylogeography of water buffalo (Bubalus bubalis).. https://doi.org/10.1111/jbg.12141. 25780854. In this paper, an account of various aspects related to buffalo reproduction are given. Fundamental concepts of the reproductive physiology as well as manipulation of the reproductive function will be presented. This will include an overview of the most recent developments of the oestrous cycle and the ovulation control, new strategies of reproductive management for the improvement of genetic gain and the application of newly developed reproductive technologies, such as in vitro embryo production, embryo and sperm sexing and cloning. Buffalo plays a pivotal role in the agricultural economy of many Asian, European, African, and Latin American countries. Among farm livestock buffalo is being increasingly recognized as an animal for milk, meat, and draft. Despite its significant contribution as a multipurpose animal, this species has received little of the care and attention which it rightly deserves. A major bottleneck in the enhancement in production potential of buffaloes has been inadequate research and paucity of information. It is often falsely presumed that the scientific information generated on cattle can be extrapolated to buffaloes. View chapter Purchase book.