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## Nutrition and reproductive underperformance of cattle in Nepal: A short review

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### Abstract

Livestock sector plays an important role in Nepal's economy and backbone of the rural community. This paper presents a short review on nutrition and their incidences of reproductive problems in livestock industry of Nepal. Multiple factors affect the reproductive efficiency of animals. Nutrition plays a major role in enhancing the reproductive efficiency of animals. Protein, vitamins, and micro minerals are top most important to optimize reproduction in livestock. Inadequate nutrition, which influences on negative energy balance, body condition score, hormonal imbalance, anestrus and delayed puberty and their effect on reproduction has been studied. Another is management part, due lack of proper management industry facing the many non-infectious problems like infertility, anestrus, retention of placenta, repeat breeding are the major reproductive problems. Sufficient nutrition, feeding, and proper management practices prevent the underperformance reproductive problems in Nepal.

**Keywords:** cattle, Nepal, nutrition, reproduction

### 1. Introduction

The livestock plays an important role in Nepal's economy and important sub-sector of our agriculture. This sector providing employment opportunity to unemployed and underemployed people of the rural community (Karki, 2018) [27]. Livestock is domesticated animals raised to produce milk, meat, wool, manure and will to continue increasing with economic growth, increase in household income and urbanization (Sah, 2016) [16]. Nepal is an agricultural country, most of the animal's exhibit all over the country, whether it is for home purposes or business. Agriculture and animal husbandry for a village of farmers is a backbone in the rural community. About 25.68% (Karki, 2015) [28] of the people of the country are in animal husbandry practices, such as cow, buffalo, pig, goat, swine, sheep farming (Neupane *et al.*, 2018) [38].

Livestock reproduction is one of most important part of farming system. Reproduction directly relates to economy of farmers and economy depends on animal's fertility, ovulation, puberty and sexual maturity, new born calf, milk production. Reproduction is an expensive trait, which requires more nutrition than normal body growth and development (Raubenheimer and Simpson, 1997; Simpson *et al.*, 2004) [42, 48]. Only after when the body development goes on then the reproduction initiate and it requires more and more energy and nutrition for the development and preparation of reproductive tract, organs, development, initiation of pregnancy, lactation and maturation of fetus (Ryan *et al.*, 1992) [45]. Reproduction is a critical component of the livestock industry. According to the 2012 Nepal Agricultural Development Strategy (ADS), reproductive insufficiency is one of the major problems facing the Nepalese livestock industry. The reproductive performance of livestock is the most important necessity for sustainable production systems (Nuraddis and Ahmed, 2017) [39]. Reproductive performance is affected by many factors such as nutrition, breed and genetic, abortion, repeat breeding, uterine and vaginal prolapse, dystocia, retained foetal membrane, poor nutrition, incorrect estrus detection, poor management, postpartum anestrus, calving interval, and ovarian disorders, disease, twinning, stillbirth, infections and metritis (Boden, 2005; Shefiraw *et al.*, 2005; Lobago *et al.*, 2006; Hudson 2011) [5, 47, 32, 23].

### 1.1. Nutrition

Nutrition is one of the factors which plays an important role in the physiological process,

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hormonal mechanism, and development of reproductive organ (Randal, 1990) [41]. Inadequate nutrition affects the reproductive performance of animals such as delay puberty, sexual maturity, gonadal and developments of reproductive parts, hormonal regulation (Hetzel, 1990; Kreplin & Yaremco 2009) [21, 29]. Protein, vitamins, macro and micro minerals (Calcium, Phosphorous, iodine, zinc, copper, cobalt, selenium, manganese) have an impact on reproductive efficiency, deficiency of these causes reproductive disorders in cattle and buffalo (Pradhan and Nakagoshi, 2008; Dua 2009; Kumar *et al.*, 2014) [40, 15, 30]. Nutrition is an important part of influencing reproductive performance in animals (Baruselli *et al.*, 2001) [3]. There is a problem in animal husbandry practices due to lack of new approaches in the farming system, the way of farming system is existing from the past. Where animals were grazed in the jungle, grassland, and corner side of the road, tree fodder, kitchen garbage, and grass at the time of the season are the main source of nutrition for livestock. In this system, animals are not getting required amount of nutrition. Deficiency of grass at off-season time, deficiency in concentrate feeding causing the animals under-nutrition is seen which causing the problem of reproduction such as delayed puberty, postpartum anoestrus, poor body condition, infertility, decrease Gonadotropin Releasing Hormone (GnRH) secretion, loss of body weight, interferes with normal ovarian activity (Boland *et al.*, 2001) [7].

## Nutritional causes of reproductive problems in cattle

### 1.1.1 Nutrition and endocrine system

Nutrition, especially certain nutrients can influence the hormonal status of the animal (Pradhan and Nakagoshi, 2008) [40]. After parturition, pituitary and ovaries responses by hypothalamic stimuli is related to nutrition (Harms *et al.*, 1974). Role of nutrition in Gonadotropin Releasing Hormone (GnRH), Follicular Stimulating Hormone (FSH), Luteinizing Hormone (LH), Growth Hormone (GH), follicle growth and for steroidogenesis (Pradhan and Nakagoshi, 2008) [40]. Some evidence found that the sensitivity of pituitary to GnRH is decreased through under-nutrition. Pituitary content of LH is lower in thin ewes (Tatman *et al.*, 1990) [50] and synthesis is suppressed under-nutrition. Poor nutrition not only suppresses LH secretion but also reduces ovarian responsiveness to LH. Failure of ovulation was always associated with the absence of preovulatory LH (Mackey *et al.*, 1999) [33]. Ewes on low planes of nutrition show reduced ovulation rates (Haresign, 1981) [18]. Different levels of dietary intake affect the pattern of follicular growth and luteal function during the oestrus cycle (Murphy *et al.*, 1991) [37]. It is known that minerals play an important role in the action of hormones and enzymes and their deficiency affect reproductive performance (Bearden *et al.*, 2004) [4]. A Calcium-dependent mechanism, responsible for major steroidogenic pathways, and Calcium have a role in steroidogenesis by utilization of cholesterol by mitochondria and by stimulating the conversion of pregnenolone to progesterone (Hurley and Dowane, 1989) [24]. Additionally, GnRH stimulation of LH release from pituitary depend upon Ca-dependent mechanism, LH is not released in the absence of Ca (Hurley and Dowane, 1989) [24]. In sheep, there is evidence that glucose availability may be a regulator of LH secretion (Bucholtz *et al.*, 1996) [8]. In lambs, prepubertal under-nutrition prevented the initiation of ovulation through inhibition of LH secretion.

### 1.1.2 Nutrition and Anoestrus

A decrease in the concentrations of LH and suppression in the frequency of LH pulses had been reported previously.

Richards *et al.* (1989) [43] found that in nutritionally induced beef cows, there is a decrease in LH concentration, heifers (Imakawa *et al.*, 1986) [31] and gilts (Armstrong and Britt, 1987), and this is occurred due to reducing in GnRH secretion from the hypothalamus. Reduced in Dry Matter Intake (DMI) at early lactation in high yielding cows and is associated with Negative Energy Balance (NEB) due to high metabolic loads delay the post-partum renovation of LH pulsatility, resulting from the prolonged anoestrus (Connor *et al.*, 1990; Hegazi *et al.*, 1994) [11, 20]. Calcium, inorganic phosphorus, total protein, cholesterol and glucose is low in true anoestrus of buffaloes and urea is high in cyclic anoestrus buffaloes (Bohara and Devkota, 2009) [6]. Therefore, inadequate nutrition causes anoestrus in buffaloes (Devkota, 2018) [18] and the deficiency in minerals like Calcium, Phosphorous, copper, zinc, and manganese are associated with anoestrus in dairy cows (Pradhan and Nakagoshi, 2008; Kumar *et al.*, 2014) [40, 30]. In cattle low Body Condition Score (BCS) cause possibility of nutritional anoestrus.

### 1.1.3 Nutrition and delay puberty

Leptin which is produced by white fat cells derived hormone is one of the factors which plays a role in puberty (Frish, 1984) [17]. Oestrus is associated with delays in the regaining of leptin concentrations in the body and abnormal post-partum reproductive cycles is associated with low concentrations of leptin (Kadokawa *et al.*, 2000) [26]. Leptin could regulate the GnRH neural activities autonomously of other nutritional factors, there is evidence that the presence of leptin receptors in the hypothalamus (Zamorano *et al.*, 1997) [52] and the capability of leptin to stimulate GnRH release from the hypothalamus (Yu *et al.*, 1997) [51]. Adequate nutrition resulted in the growth of follicles and the beginning of ovulation (Ibáñez & Zegher, 2006) [25]. It has been shown that under-nutrition in the prepubertal stage shows retards the development of sexual organs, delay the onset of sexual activity and puberty, and delay fertile mating in domestic animals.

### 1.1.4 Nutrition, negative energy balance (NEB) and body condition score (BCS)

The nutritional status of animals can be retrieved in terms of their Body Condition Score (BCS). Thus, the overall nutritional status is measured in the form of BCS. Reproductive efficiency in dairy cattle is directly related to BCS (Devkota, 2018) [18]. In buffaloes, the higher ovarian inactivity in summer is associated with poor BCS indicating poor availability nutrition in the summer season (Ali *et al.*, 2009; Devkota *et al.*, 2012) [1, 12]. Balanced nutrition and nutritional availability completely affect the BCS of dairy cattle (Maina *et al.*, 2008) [34], whereas the true anoestrus and abnormal ovarian cyclicity in buffaloes are negatively correlated with the BCS (Devkota *et al.*, 2012) [12]. Poor BCS during the period of early lactation leads to lengthy postpartum anoestrus (Dziuk and Bellows, 1983; Robinson, 1990) [16, 44]. Therefore, the BCS of animals directly redirects the nutritional status, which is very important to understand the ovarian activity in animals. According to Bohara and Devkota (2009) [6], the BCS in true anoestrus buffaloes was lower than that in the silent anoestrus buffaloes.

It is well known that high producing cows are prone to NEB at early lactation, because of the high nutrition mobilization rate. Prolonged energy shortage leads to losing body condition which is associated with the NEB and which may affect reproductive efficiency and reproductive failures.

Nutritional conditions of cattle can be monitored by BCS system, a cow with a poor BCS at the time of parturition have poor reproductive performance (Markusfeld *et al.*, 1997) <sup>[35]</sup>. Cows which loses BCS after parturition have low reproductive performances (Domecq *et al.*, 1997) <sup>[14]</sup>. Cows with lower BCS have lower conception rates compared to cows with a higher BCS (Moreira *et al.*, 2000) <sup>[36]</sup>.

## 2. Discussion

Excluding the infectious causes of reproductive problems in cattle. Husbandry practices in Nepal is traditional in which involves grazing in forest, grazing on roadside, things left over from the kitchen. Feeding of grass and tree leaves only in the season of availability. Where the animals are driven in a pasture land or forest for grazing during the day, and are not supplemented at the stall. It is very rare to see concentrate feeding in animals. A lot of problems is seen in offseason, where green grass and tree leaves are unavailable. In offseason period the farmer fed only dry straw and water. In Nepal, subsistence farming system, only for livelihood is one of the major problem for improvement in cattle husbandry practices. Concentrate mixture wheat, rice, maize, rice barn cooked in a single pan is usually feed only in before and after parturition. This mixture of nutrition is not sufficient nutrition required for animal. Anoestrous and delayed sexual maturity is the major problems seen in under nutritional animal which direct impact on long calving interval of animal and economic condition of farmer. Long calving interval cause losses in feed, milk production and losses in calf. Today's community and government forest didn't allow animals to graze in forest. So, that the problems in nutrition related reproductive problems are more than the past.

## 3. Conclusion

This short review shows the relation between nutrition and reproductive underperformance of dairy cattle in Nepal. By modifying the traditional farming system in improvement way by hay, silage, off season green grass and tree cultivation, concentrate feeding according body weight and stage can reduce low reproductive performance problems. It is clear that nutrition, traditional farming system and management is directly related to reproduction in the livestock industry. The nutrient either high or low amount has been revealed to be capable of altering reproduction in farm animals. The basic to improve reproduction is adequate nutrition and management. Attention in the following point can increase reproduction efficiency of Nepalese livestock; attention in proper nutrition (protein, vitamins and micro minerals) and feeding practices improve reproductive performance of cattle.

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