# Profitable Dairy Farming: Challenges of One Calf Every Year


## Abstract

Commercial dairy farming is an emerging segment that strengthens the economy of farmers and the nation. A successful "One Calf a Year Programme" is the key to profitable dairy farming. It has been observed that even with proper farm management and veterinary aid, the conception rate has been low and the Repeat Breeding Syndrome (RBS) was very commonly experienced. The main obstacle seems to be the functional hurdles of the reproductive system and often these functional hurdles remain hidden or undiagnosed due to lack of diagnostic facilities, leading to poor fertility. These functional hurdles directly affect fertility and are the major causes of RBS. Various published studies have shown that Indian traditional science can offer a positive solution to overcome the functional hurdles that lead to infertility. It has been reported that certain specific herbs and polyherbal preparations have been proven to be effective in normalizing the functional hurdles leading to an increase in conception rate. Such products have been receiving excellent responses from Indian dairy farmers.



**Key words: Fertility, Calf A Year, Functional hurdles, Repeat Breeding, Herbal remedies**


## Introduction

The dairy sector has been developing as a major wealth provider for farmers in India, ranking first amongthe world's milk-producing Nations since 1998. India has the largest bovine population in the world, with 303.76 million heads, including cattle, buffalo, Mithun, and yak [1]. According to the 20$^{th}$ National Livestock Census conducted in 2019, thetotal number of Cattle in the country was 193.46 million, while the buffalo population was 109.85 million. It included 81.4 million milch cows and 55 million milking buffaloes.[2] There has been a steady improvement in the productivity of milch animals in the country due to sound development policies, good veterinary services by the government and non-government organizations, and the untiring efforts of the late Dr. Varghese Kurien, the father of the white revolution [3, 4, 5, 6].

Every dairy farmer desires to earn maximum profits from dairy animals, which can be achieved by ensuring the good health of their animals. One of the requirements for achieving good health is deworming the animals at regular intervals while providing proper nutrition. Adult animals are provided with adequate quantities of the mineral mixture, apart from forage and concentrate. Special measures are also taken to reduce heat stress by continuously providing clean drinking water and adequate shade or cooling systems [7]. Regular vaccinations and timely veterinary care are also essential to keep them healthy.

Veterinary doctors and paravets engaged in providing breeding services (AI technicians) play a crucial role to enhance profitability through improvement in the productivity of dairy animals. Enhanced profitability can be achieved by obtaining a calf every year. The first step in this direction is to create awareness among dairy farmers through veterinarians and AI technicians regarding timely heat detection. The next step is achieving a high conception rate by properly handling semen, thawing at a proper temperature, performing AI at the right time and condition, and depositing the semen at the mid-cervix region. If the animals fail to conceive, the veterinarian tries to improve the reproductive health of the animal by recommending a mineral mixture in diet or treat the infection in the reproductive system with douching, parenteral antibiotics, and even by correcting hormonal imbalance through hormonal therapy [8,9,10]. After taking all the managemental and other corrective steps, the average conception rate (HCR) in crossbred Holstein Friesian heifers has been reported at 55–60% only [11]. The mean conception rates for nulliparous and primiparous cows from 2012 to 2018 were 55.2% and 39.2%, respectively [12]. This low conception rate is the first indication of impaired fertility of the animal.

**Fertility – the Key Factor**

The key to maximizing profits is consistency in the fertility status of dairy animals. In broad terms, "fertility" is defined as the ability to produce offspring. In the dairy industry, female fertility refers to the ability of a cow to conceive and maintain pregnancy within a specific time period, where the preferred time period is determined by the particular production system in use [13]. Fertility also influences the lifetime performance of the animal. For dairy cows, it is necessary to ensure a calf every year. Regular breeding depends upon the normal functioning of the reproductive system [14]. In order to breed regularly, the cow must have functional ovaries, display estrous behaviour, mate, ovulate, fertilize, conceive, sustain the embryo through gestation, calve and resume estrous cyclicity and restore uterine function after the calving [15].

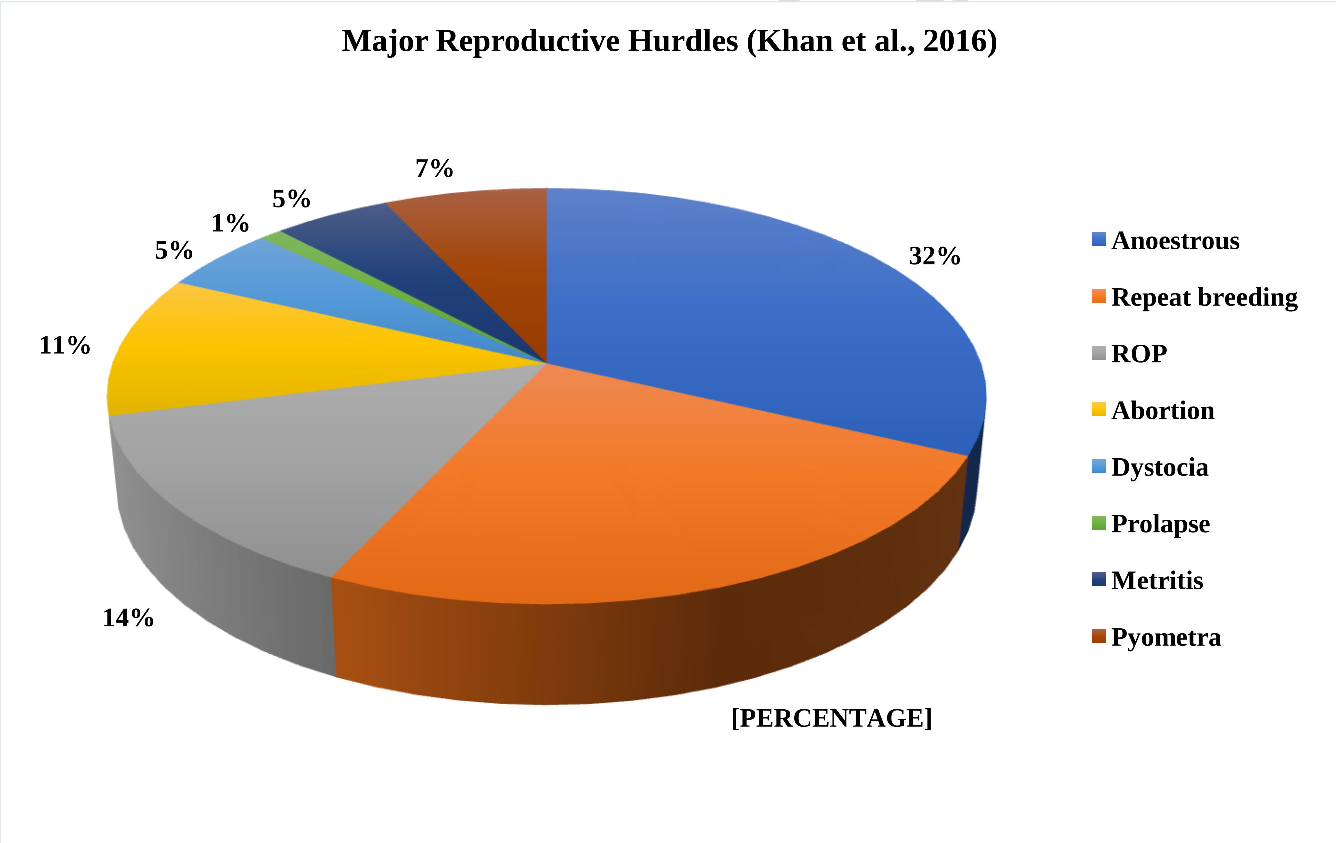
**Challenges of Improving the fertility**

Proper detection of oestrous and timely insemination is the first step. Generally, about 50 percent of oestrus periods go undetected on the farm [16]. Animals should be inseminated around 12 hours after the first sign of oestrus [17]. The unavailability of diagnostic equipment to detect heat is the prime hurdle for field veterinarians. Thus, the greatest limiting factor to achieve successful fertility is the detection of functional hurdles.

## Major hurdles in achieving better fertility

In dairy animals, Repeat Breeding Syndrome and Anoestrous are the main issues leading to the "Calf A Year Programme failure." Collectively these two conditions affect nearly about 60 percent of dairy animals. [18]. Major hurdles in achieving higher fertility are presented in Figure 1. The impaired functions of the reproductive system ultimately affect the fertility of dairy animals, resulting in huge losses to the farmers. Under these conditions, veterinarians are not able to diagnose these functional hurdles easily, and mostly they remain un-noticed, due to lack of advanced equipment. Hormonal treatments are easily available, but they need experts and trained persons for better results with the least hormonal disturbances. The cost of hormonal treatment is always on the higher side.

**Figure 1. Major Reproductive Hurdles.**



### Functional hurdles of fertility

There are innumerable etiological factors of functional infertility, which are reviewed below.

### Repeat breeding syndrome (RBS):

This is one of the commonly seen syndromes due to functional hurdles. A repeat breeder is defined as a cow/buffalo that has calved before, is less than 10 years old, has normal heat cycles with no palpable abnormalities, but is unable to conceive even after breeding for three times or more [19]. In normal heifers, 100 percent fertilization has been found one day after breeding. This drops to 85 percent in cows and 60-70 percent in repeat breeders. Therefore, repeat breeders seem to have more of a fertilization failure. If embryos are fertilized and transferred, one can have normal pregnancy rates.

Functional hurdles affecting bovine fertility are presented below:

1. **Uterine pH:** The pH of bodily secretions has long been recognized as one of the body's primary innate defence mechanisms, preventing microbial infections through the skin, mucous membranes, and reproductive and alimentary tract [20]. It may be assumed that vaginal acidity-alkalinity in dairy animals fulfills the same protective function. Thus, pathological variations of vaginal pH values may act as a predisposing factor for infections of the bovine genital tract, resulting in conditions such as bovine necrotic vulvo vaginitis (BNVV), a syndrome causing a major problem in Israeli dairy herds [21]. A change of one pH unit may determine the difference between healthy vaginal flora and heavily infected vaginal flora [22]). Although the pH value of human vaginal secretions is not routinely used in the diagnosis of vaginal infections, it is a reliable tool for the screening of bacterial vaginosis [23]. The pH baseline values found were 7.35, 7.48, and 7.58 for heifers, first calf heifers, and cows respectively, whereas the median for all examined groups was 7.50 [20].

   **Role of pH in gamete protection and survival:** Oviductal fluid has a positive effect on sperm viability [24]. The oviduct provides the nutrients necessary for oocyte survival, and enzymes with an anti-oxidant effect in the oviductal fluid [25,26]. Moreover, sperms in the female genital tract are considered foreign cells, which affect the survival of sperms due to immunological surveillance [27]. The pH and environment of the reproductive tract play a crucial role in sperm motility and viability [28]. A hostile uterine environment with disrupted endocrine pathways, perturbations in ovarian function, and oocyte development are among the causal links between uterine infection and infertility [29].

2. **Endometrial glands and uterine fluid:** The uterus actively secrete many proteins and some proteins transudate into the uterine lumen from blood. These proteins have complex functions of embryonic growth, implantation, and maternal recognition of pregnancy. A uterine protein named blastokinin (uteroglobulin) influences the formation of blastocysts from morulae [30]. Many endometrial proteins are secreted during early pregnancy in cattle [31] and other domestic animal species, which help in embryonic implantation.

3. **Affections of Oviducts:** The oviduct is of functional importance in many ways. It is involved in the process of gamete transport, fertilization, and subsequent transport of the developing zygote until it reaches the uterus [32,33,34].

4. **Salpingitis:** Salpingitis is usually caused by uterine infections, cervix, or vagina infections. Buffaloes with salpingitis may be sterile, depending on the severity of the condition [35]. Salpingitis develops following the abortion, retained fetal membranes, septic metritis, and pyometra [36,37]. The accumulated fluid around the oviduct creates a hostile environment that will prevent the implantation of an embryo [38].

5. **Poor uterine tone:** Postpartum reproductive health in dairy cattle is judged by complete uterine involution (return to its normal size and position), free from infection, and for cows to have cyclic activities by the time they enter the breeding period [39,40,41]. Uterine involution consists of the reduction in uterine size, clearing of bacterial contamination, sloughing of caruncles, and regeneration of the endometrium [42] and is completed within 28 days of postpartum [43]. Resumption of cyclicity also occurs during this interval, with the first ovulation occurring around days 40 to 45 postpartum [44]. This interval can be affected by nutrition, body condition, and parity and can be extended due to uterine disease [45].

   Uterine blood flow is generally considered to be increased in association with oestradiol elevations. This has typically been investigated in nonpregnant cows with involuted uteri. However, the response of uterine vasculature to oestradiol may be mediated by adrenergic receptors. Vascular smooth muscle contains alpha-adrenergic (vasoconstricting) and beta-2 (vasodilating) receptors. Uterine vasculature has been shown to be dominated by alpha-receptor activity although beta-receptors can also modulate uterine blood flow [46]. Oocytes and embryos are immotile. They do not have the ability to move as the sperms do, and they must be transported passively. Two essential components are involved in the transportation of the oocyte to the fertilization site: the coordinated contractions of the smooth muscle cells (myosalpinx or muscular layer) along the length of the oviduct and the ciliary beat of the epithelial cells. Fimbriae finger-like projections of the Infundibulum glide over the surface of the ovary. This action enhances the chances of ovulated oocyte being captured by the infundibulum. If oviductal contractions are altered, the oocyte will not reach the fertilization site [47,48].

6. **Blockage of oviduct:** Affections of the oviduct result in occlusion of the lumen preventing fertilization or creating an unfavorable environment for fertilization. A unilateral affection results in infertility, whereas a bilateral affection results in sterility. The overall incidence of affection of the oviduct varies from 10 to 29 percent [49,50]. A higher incidence of oviductal affections has been reported for buffaloes as compared to cattle [51,52].

7. **Early Embryonic Death:** Embryo survival is a major factor affecting the production and economic efficiency in all systems of meat and milk production by ruminants [53]. In beef cattle, estimates indicate that the fertilization rate for oocytes is 90 percent, whereas average calving rates to a single service are between 40 percent and 55 percent, suggesting a rate of embryonic/foetal mortality (excluding fertilization failure) of about 35 to 50 percent [54]. Most of the embryonic loss (70-80 percent) occurs in the first 3 weeks of pregnancy, particularly between 7 and 16 days of pregnancy [55]. In a disturbed environment of the reproductive tract, a poor supply of uterine proteins disturbs embryo implantation, and the deficiency of Vitamin A predisposes to low rates of fertilization and embryonic mortality [56].

8. **Ovulatory defects:** Ovulation in a cow is typical since it occurs 10-12 hours after the end of behavioral oestrus and 18-26 hours after the ovulatory LH peak. During oestrus and after the end of oestrus, several follicles undergo development but usually, only one or occasionally two ovulate, and the other follicles regress and become atretic [57].

**Unhealthy Ovum:** A female is born with all the primordial follicles, with no further development and division of primordial follicles, which may further develop into primary, secondary, and tertiary follicles or degenerate [58]. Prior to ovulation, oogenesis, and hormone production, both occur in the follicle. This process of follicular growth is known as Folliculogenesis. The activation of primordial follicles leads to an increase in the size of the oocyte. Further growth leads to the formation of a single dominant follicle [59]. A large healthy oestrogenic follicle at the time of ovulation is important for the establishment of a successful pregnancy [60]. Cows with uterine diseases have smaller ovarian follicles and lower peripheral plasma oestradiol concentrations [61].

**Delayed ovulation:** The hormone which is important for delayed ovulation is delayed LH surge, which plays a big function in the failure of fertilization. If ovulation had not occurred by 24 hours after service, the cow should be re-inseminated. Delayed ovulation is generally assumed to be one of the causes of failure of conception in cyclic non-breeders [62].

**Anovulation:** Anovulation has been defined as the absence of ovulation which leads to true anoestrus or cystic ovarian disease or both. Sometimes anovulation is observed before the onset of the anovulatory anoestrus with the follicle regressing and becoming atretic. If cows are examined per rectum during the first few weeks after calving, several enlarged ovulatory follicles can often be detected. They are incorrectly described as cysts, but they are transient and do not persist even if no treatment is given [63].

**Cystic ovaries:** Ovarian dysfunctions like cysts occur most often during the early postpartum period when there is a transition from a non-cyclic condition during pregnancy to the establishment of regular cyclicity. The most widely accepted hypothesis explaining the formation of a cyst is that LH released from the hypothalamus-pituitary is altered and the pre-ovulatory LH surge is either absent, insufficient in magnitude, or occurs at the wrong time during dominant follicle maturation, which leads to cyst formation [64,65,66,].

**Follicular cyst:** There are several definitions used to describe ovarian follicular cysts and the traditionally accepted definition is that they are follicular structures of 2.5 cm or larger that persist for a variable period in the absence of a corpus luteum [67]. The follicular cysts are anovulatory structures, and the cow will remain infertile as long as they persist [68]. Cystic ovarian disease is the most common endocrine pathology to be found in dairy cows, and the incidences are believed to vary from 1 to 30 percent, depending on herd and breed conditions [69].

**Luteal cyst:** The luteal cystic ovarian disease is characterized by enlarged ovaries with one or more cysts, the walls of which are thicker than those of follicular cysts because of a lining of luteal tissue [70]. Cysts with thicker walls produce high levels of progesterone. In appearance, they are smooth and rounded, with a spherical cavity that is lined by a layer of fibrous tissue surrounded by luteinized cells [71]. Luteal cysts are considered anovulatory cysts and are associated with infertility and mucometra in cattle [72]. Compared to follicular cysts, luteal cysts are more likely to persist over long periods [73].

9. **Anoestrus:** Anoestrus is the failure of cows to exhibit overt oestrus. The postpartum period plays a pivotal role in cow reproduction. The duration of postpartum anoestrus has an important influence on reproductive performance. Pregnancy can be a prominent cause of anoestrous and must always be ruled out before taking any action. Many factors, such as feeding, management, and milk production level can affect the functioning of oestrus. While these cows are not observed in oestrus, they have normal oestrous cycles and will respond well to the ovulation synchronization Programme [74].

   **True anoestrus:** It can be defined as the ovaries that may be quiescent and inactive, which is referred to as a true anoestrus. The reasons for the failure of normal activity may be insufficient release or production of gonadotropins to cause folliculogenesis, or it may reflect the failure of the ovaries to respond [75].

   **Sub oestrus or silent heat:** There may be normal cyclic ovarian activity but the cow is not showing normal behavioral signs. This is described as sub-oestrus or silent heat. The first and second post-partum ovulation are frequently not preceded by behavioral signs of oestrus and are thus truly silent heat. After the second oestrus, it is unlikely that true silent heats may occur [76].

**Economic Losses Due to poor fertility**

Poor fertility is a major cause of economic losses and a major limitation to the achievement of optimum efficiency in the livestock production system [77]. Economic losses associated with poor fertility include the cost of veterinary intervention, the expected cost due to calf loss, the cost of cows culled, and the cost of milk loss [78,79]. Impaired fertility increases the cost of milk production and reduces the income of dairy farmers, affecting the living standard of farmers [80]. Additional losses occur if the subsequent calving period is extended, resulting in higher production costs and weaker calves weaning in the following year [81].

Declined fertility results in a loss of 20-30 million tonnes of milk annually in India, which translates to a loss of nearly Rs. 50,000 to 80,000 crores annually. At a micro level, each missed heat is a missed opportunity, incurring a loss of milk production for 21 days, with an additional cost of feeding and maintenance [82].

As discussed above, one or many functional hurdles result in long-term and huge economical losses due to impaired fertility and "Calf a Year failure." To overcome or correct these functional hurdles, herbs can be used effectively without any side effects. Like in human fertility challenges, herbal/ayurvedic natural products have proved to be beneficial in overcoming these challenges. Similarly, in the veterinary segment, some products have proved to be effective against the challenges posed by functional hurdles. Herbal preparations containing Latakaranja, Kokilaksha, Gokshur, Shatavari, Ashwagandha, Swarna Bhasma, Vang Bhasma, etc, have proven to be effective in normalization of uterine pH, correct salpingitis, oviductal blockages, and other reproductive functional hurdles. These preparations have successfully helped to improve fertility rates in ruminants. More studies may be conducted on herbal remedies for impaired fertility [83].

## Conclusion

Improving fertility and achieving 'One calf a year' is the prime motive of every dairy farmer. However, even if they ensure all managemental precautions, the percentage of AI failures is still on the higher side. Even after undergoing costly hormonal treatment, there may not be much improvement in fertility rates, also, such treatments would necessarily have side effects.

Such failures in fertility can be majorly attributed to functional hurdles. Normalization of impaired reproductive functions is very crucial for profitable dairy farming. Various studies have proved that herbal remedies are effective in normalizing functional hurdles. As a result, many veterinarians prefer using herbal remedies because they have no side effects.



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