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A Variety of Oversight Strategies to Enhance the Productivity and Sustainability of Dairy Farming

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Abstract

Scientific animal husbandry practices owing to the flourishing milk, meat and daily income generation of rural India. Efficient management of livestock by considering age, especially production status of animals, climatic conditions etc. determines the productivity through livestock rearing. Requirements and manage-mental aspects of livestock vary as accordance with the production status and age of livestock. Livestock's requirements and disease susceptibility is directly linked with production status of animals. Proper area allocation, along with other clinical and manage-mental interventions influences the productivity. Thus, aforesaid article developed to discuss key insight considerations to uplift the humane animal husbandry practices.

Keywords: Livestock; Age; Production; Management.

Introduction

Indian livestock sector is one of the largest and most potent sectors to enhance the productivity and self-sustainability of country. Indian economy is largely contributed through agriculture sector which is mainly driven by our rural society. Agriculture sector provides economy, occupation to sustain the daily livelihood. Such sector is back-bone of rural survival. Agriculture sector is critically linked with livestock sector. Livestock sector helps to driven the agriculture sector in better way of proliferation such as, it provides physical means, direct currency return and overall complementary partner to driven the agriculture sustainability. Livestock sector may provide direct day to day return to run the livelihood of farmers and serve a real state to the marginal or landless farmers; those are primarily dependent on agriculture sector. Proliferation of livestock sector directly reflects the wealth and profitability of farmers (ILRI, 1995).

Thus, efficient management of livestock may help to enhance the development of agriculture sector through sustainability, better return and improved social value of farmers (Bettencour et al., 2015). In our country, various types of agro-climatic conditions (15 agro-climatic zones) exist. Such climatic variations directly or indirectly reflect

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the productivity and well-being of our livestock population. This article is mainly focused on various critical manage-mental aspects for efficient running of livestock/dairy in various seasons with various age group animals to extract more and more profitability.

Construction of modern dairy farm

Such type of lay out/design (Fig.1) of modern dairy farm is able to manage different age group of livestock, generally exist in the dairy farm. Separate habitat/shed are providing for each age group so that they can be efficiently managed with lesser endeavour input and higher return. The farm should be well covered by boundary or may be through wire fencing. On the entry point (having broad sized gate), there must be any provision of disinfectant, so that dairy workers or visitors have to pass through such disinfectant. Such provision helps to decline the chances of disease proliferation and entry of any disease causative agents.

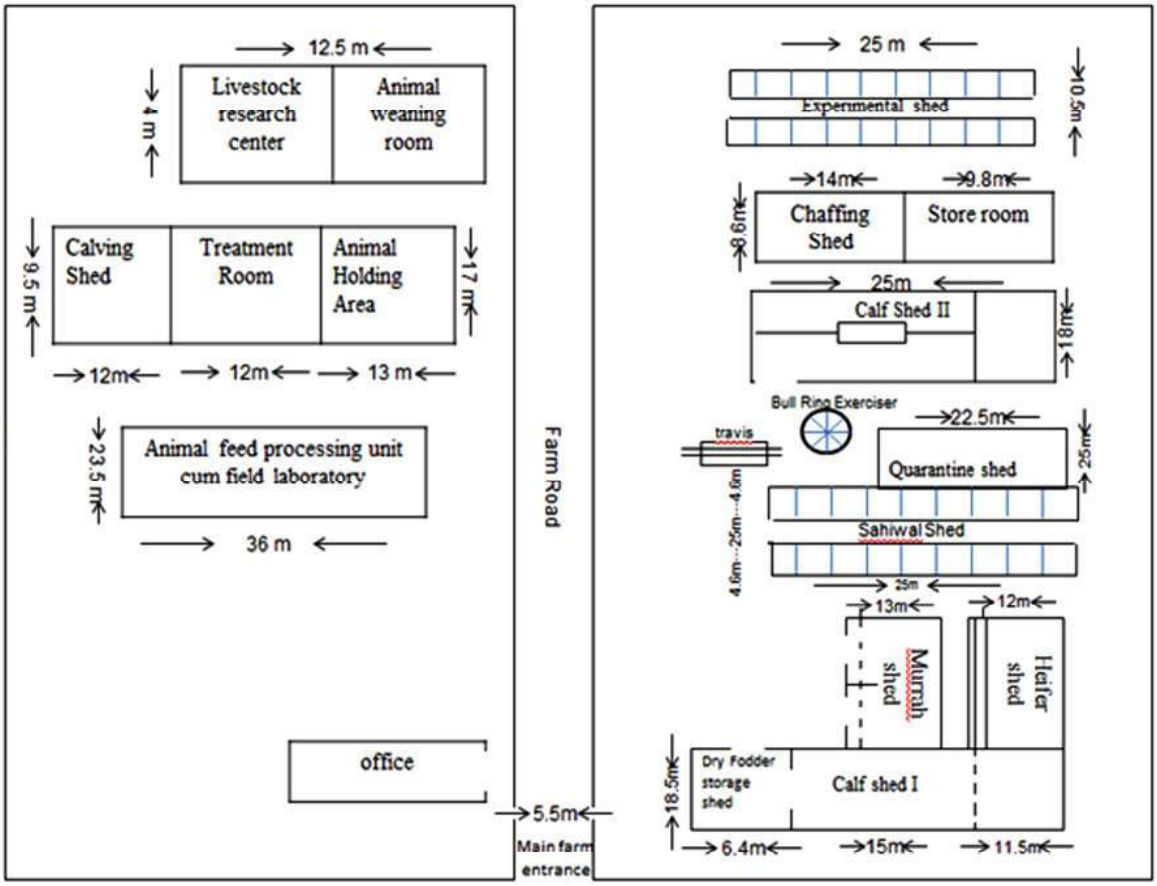

Fig.1 Schematic model of dairy farm.

At the start of entry point of dairy farm, there must be a provision of quarantine room. Such provision helps to critically investigate and monitoring of out siders/ livestock, those have been purchased or going to mixed with the existing livestock population of dairy farm. At the entry point there must be a control room/ manager room should present. Such things will help to manage the entire farm in better efficient way. There must be a quit broader passage (bifurcating road) from entry point to last. Such thing will help to easy access the entire farm. Calves shed, heifer shed, dry animal shed, lactating animal shed, calving room, treatment room etc. must be present to manage various age groups livestock in accordance with their nutritional needs and lesser labour inputs as mentioned above in the dairy model. Calves shed and lactating animal shed should be in close vicinity, it help to nurse the calves efficiently and also helpful in milking of lactating animals. Each shed should have sufficient open and close area (Approx. 1/3rd close area and 2/3rd open area). Ample source of clean water tank and feeding mangers must be present to ensure the water and feed supply.

Table 1: Floor, feeding manger and watering spacew requirements of dairy animals.

Type of animals	Floor space per animal (m^2)		Feeding (manger) space per animals (cm)	Water tough space/ animals (cm)	Mode of housing
	Covered area	Open area			
Adult buffaloes	4.0	8.0	60-75	60-75	Groups of below 25-30
Adult cows	3.5	7.0	60-75	45-60	Groups of below 25
Bullocks	3.5	7.0	60-75	60-75	Pairs
Bulls	12.0	120.0	60-75	60-75	Individual
Down calvers	12.0	20-25	60-75	60-75	Individual
Heifers	2.0	4.0-5.0	45-60	30-45	Groups of below 25
Older calves (>8 wks)	2.0	4.0	40-50	10-15	Groups of below 15
Young calves (< 8 wks)	1.0	2.0	40-50	10-15	Individual or in groups of below 5

Source, ISI standards for housing in India

Apart from it, Travis of optimum size, in accordance with the normal height of various age group livestock, must be installed in open area of each shed. Close area (Table.1) of each shed should be well covered in all dimensions and there must be provision of ventilation. Open area should covered with sufficient height, so that animals are not directly visible for out siders/visitors. Both open and covered area must have non slippery floor and not interrupted flow of waste liquid or semi-solid excreta. Open area (Table.1) of all sheds should have provision of any shadow premises, either natural plant may be there or provision of any artificially shadow. Such provision helps to declines the summer stress. Height of mangers/ water tank should be installed in such a manner so that the animal may feed/ drink easily. On the entry point of individual shed, there must be the provision of disinfectant. Apart from residential sheds of animals, there must be some other facilities such as, store room for feed must be there in the dairy farm and such things should be in the middle or most accessible place of dairy farm. For efficient running of dairy farm, there must be any feed processing unit present (if feed processing unit is not present, then the dairy owners have to rely on marketed commercial dairy feed) so that the nutritional requirements may be critically investigated. Purchasing of raw feed ingredients, its procurement and formulation of concentrate helps to minimize the feeding cost as well as will it helps to meet the scientific requirement of animals.

Management of calves

Calves are most disease susceptible, key dairy return decider and future investment of dairy farm. Due to least developed immune status, such initial stage of life (calf hood stage) is most susceptible for diseases or any type of natural or manmade stress. Efficient management of calves helps to replace the herd in more efficient with better productivity level.

Table.2 Feeding schedule of calves (0-6 months of age group)

Age (Day)	Colostrum (Lit.)	Milk (Lit.)	Calf starter	Green fodder
0-4	2-2.5 (1/10th of body weight)	-	-	-
4-30	(1/10th of body weight)	2.5-3.0	-	Ad lib, preferably of leguminous fodder (After 15 days)
30-60	-	3.0-4.0	50-100g	Ad lib
60-90	-	3.0-3.5 (Fat separated milk)	100-2w50g	Ad lib (Leguminous)
90-180	-		250-750g	Ad lib(Leguminous)

As mentioned above, that the calves are the key livestock, through which the dairy owners have to replace their geriatrics herds with young animals. Thus, such calf hood stage determines the future productivity of dairy farm. Once the calves born, its all-round better management will help to declines the calf mortality and better productive herd would be available for the future sustainability of dairy farm.

Before parturition of pregnant animal, manage under isolated calving shed. Such provision helps the overall efficiently management of every aspects of advance gestational animals, it may be open-covered area allowance, vaccination requirements or nutritional requirements, extrinsic- intrinsic stress factors. Once the parturition occurs, calf should be thoroughly clean, specially its natural orifices. Such provisions helps to mount the cutaneous respiration and proper exchange through natural orifices and parallel the mother should provide jaggery. Environmental temperature should be critically monitored. If the calving occurs during extreme cold weather, then the provision of any heating source may be fire or anything else should be in territory of calf and its mother should be placed. Such provision helps to maintain homeostasis of calf, as inefficient thermal regulation system during the earlier phage of life and its mother. Just after parturition, colostrum feeding (Table. 2) should start to calf, as early as possible (within ½ hours of parturition). The dose should be 1/10th of body weight of calf. The dose should not be offered as a whole, even though, number of small packet feeding should implement. At the early beginning of life, colostrum can be efficiently absorbed and intrinsic constituents of colustrum i.e. immunoglobins (readymade antibody) provides the acquired passive immunity. After certain time of interval the intestinal wall permeability of newly born calves declines, hence exchange of immunoglobins declines very drastically. Colostrum is highly nutritive and having laxative action. Such colostrum feeding helps to provide efficient nutrition, immunity and evacuation of gastro-intestinal tract. Above mentioned dose regimen of colostrums feeding should continue till the let down of colostrum is over. After the colostrum let down, milk feeding should start with the same dose regimen and same feeding pattern, as mentioned in Table.1, upto three months of age. During 2nd week of age some quantity of fresh green should offer and such good quality green fodder helps for the development of rumen in gradual manner.

During the progression of one month of age, little quantity of calf starter (nutritionally dense gruel concentrate mixture, having >23%CP and >75%TDN) should offer. Along with calf starter, ad-lib good quality green and milk should also be offered. In gradual manner, the quantity of calf starter and green should enhance and quantity of milk offered should taper down, till 3-4 months. After 3-4 months of age, calve is gradually shifted toward composite ration of 2/3rd roughage and 1/3rd concentrate.

Management of heifer

After calf-hood stage, physically and sexually development stage before 1st calving, is termed as heifer. Such 2-2.5 year's duration is quiet important one for overall development of animal, especially reproductive development. To raise a calf from the beginning of life upto sexually mature stage may ranges 12000-15000 thousands rupees. Thus, early weight gain and declining age at 1st calving (AFC) are prerequisite things to enhance the farm profitability. AFC and average daily gain (ADG) are critically linked together. To achieve the earlier sexual maturity, higher ADG is directly associated as, on optimum weight the reproductive tract goes fully developed and able to conceive efficiently and animal's rearing cost declines. Finally results in more and more profit harvesting through dairy. Heifers should offer good quality green fodder, wheat straw and concentrate mixture, mineral mixture and along with feed additives (Heifers should provide 2.5% DM in the form of 2/3rd roughage, 1/3rd quantity of concentrate mixture and minor quantity of mineral mixture, feed additives). Growth rate of heifers should regularly monitored (ADG of >500g/day if cross breed 300-400g/day in deshi breed should insure). Climatic variable, shed dimensions must be under control to minimize the stress in heifers. Birth record of all animals should well document. Such provision helps to assume the expected sexual maturity age. To bred any heifer, either through natural or artificial insemination, the optimum balance between age and body weight is important task, as both age and weight insure the ability uterine tract to completely hold and nourish the developing fetus upto full gestational term. Apart from above mentioned strategies of heifer management, its treatment and vaccination schedule (Table. 2) is also very important task to flourish the easy going life of heifer.

If owner is going to purchase the heifer/lactating animals, he or she must critically watch some key considerations of good milking capacity animals. Before purchase of any animal, must insure at least three consecutive in front milking and should consider the average of last two milking. Apart from it, triangular dorsal view, i.e. broader back and tapering front also indicate the good milking ability animals. Udder size, udder smoothness, enormous minor blood capillary supply around udder, prominent milk vein, and symmetrical cylindrical teats are important considerations while purchasing any animals. Animals gait, big alert

eyes, skin turgidity also of minor considerations.

Management of pregnant animal

Pregnancy is one of the most sensitive stages of animal life. An excessive physiological, metabolic and bio chemical change occurs during pregnancy. Efficient progression of gestational period is prime important consideration, as it decides the productivity of dairy farm. Before going for natural insemination or AI, the owner must insure the quality of semen, like the inseminated semen (during AI), must of similar breed or breeds having similar body weight gain and during natural insemination, the average weight of both the partner must be comparable one. Pregnancy status of animal must insure by the help of recognized veterinarian through per rectal examination or USG etc. Early pregnancy determination depends upon skill and expertise of veterinarian. Once the status of animal determined, then one should go according to pregnant or non-pregnant manage mental aspects. If possible, the pregnant animal should insure comfortable isolated pen having sufficient open and cover area. Sufficient quantity of fresh drinking water must be insured. Good quality of green fodder (ad libitum), wheat straw (4-6 kg) and good quality concentrate (3.25 kg during early gestation and 3.75 kg during the advance stage of gestation) must be insured. Along with roughage-concentrate, feed additives and mineral mixture (negative DCAD diet) must insured in the ration of animals. As the pregnancy advances, the ability of animal to consume the required DM suppressed due to gradual increase in fetal size and accordingly compression the ruminal area. Thus, provision of by pass fat/ protein supplementation and feed additives helps to insure the dietary requirements of animals. During advanced stage of gestation the movement or any type of stressful condition must avoid and animal should try to maintain under best possible comfortable environmental conditions. During advance pregnancy, the stall feeding should prefer with moderate level of exercise.

At the time of parturition, provision of warm water, jaggery, sufficient bedding material and expert supervision must be insured. If the animal is progressing towards normal parturition, the above mentioned strategies must insured. Otherwise the expert advice/ treatment in case of various gynecological ailments like dystocia, retention of placenta, uterine torsion; metritis, endometritis etc. must be insured. Strictly avoid any innervations or advice of quacks.

Management of lactating animals

Lactation period is key output through dairy farming. Above mentioned input cost of around 12000-15000 before starting of lactation period may be harvested or more importantly better return through overall efficient management of lactating animals. Efficient management of PPP (Peri-parturient period, lies few weeks before, during and after parturition) is one of the important tasks as vigorous changes occur during such period. Excessive drainage of nutrient in the form of colostrum makes the animal most susceptible for various diseases. Thus efficient management is quite important one. During PPP animal should provide (-)ve DCAD before parturition and have to enhance the cation (especially Ca and P regulation) at the start of lactation. Just after parturition, animals should offer liquid jaggery to minimize negative energy balance. Total mixed ration in large number of feeding should provide so that the ruminal environment get constant one. Green fodder/ silage/ hay (5-7kg), wheat straw (4-6kg) should provide to meet the requirement of animals. Along with the green and dry roughage, sufficient concentrate (@500g/lt of milk in buffalo and 400g/lt of milk in cattle) allowance should meet. Apart from lactation requirement, 2.0kg concentrate should be offered to meet its maintenance requirement. Most simple method of concentrate mixture formulation for animals is 1/3rd maize or any other energy rich grain, 1/3rd GNC or any other protein rich supplement and 1/3rd bran. Apart from it 2-3% mineral mixture and salt resulted easy way to handmade concentrate mixture. Such concentrate mixture has around 16-18% CP and 60-65% TDN. Optimum combination of leguminous and non-leguminous fodder may reduce the concentrate allowance of low yielder animal and ultimately reduce the feeding cost. Green fodder availability does not sustain throughout the year. Thus, preservation of green fodder at the time of peak yield in the form of hay/silage may sustain the availability of year round green fodder availability. High yielders (>20lt of milk production) may not sustain its milk production until or unless some form of rumen protected supplementation is offered. Otherwise, the body reserve may deplete. Low and medium yielders can be efficiently managed through optimum combination of roughage and concentrate. In case of non-availability of green fodder, have to enhance the concentrate allowance. In case of non availability or lesser availability of green fodder, may rely on various physical/ chemical/ biological or physio chemical methods

of feed processing to enhance the nutritive value of available dry roughage and harvest more and more nutrients (4kg urea dissolved in 30lt water is sufficient for 100kg straw enrichment). Sudden changing in the body from non-lactating stage to lactating stage and simultaneously physiological and bio chemical changes in body leads to poor absorption of DMI. Thus, have to rely on good quality TMR or better meets through by pass supplementation. High producing animals should offer more than 10 meals TMR per day, if not relying on TMR then small-small packets of concentrate should provide to maintain the homeostasis of rumen. Good quality fresh feed should be available for more than 90% duration of the day. If hay feeding is practiced, offer it before concentrate. Protein source may offer mixed with energy source or may offer after energy source. Variety of green fodder feeding is advantageous, if available. Always avoid the abrupt changes in ration rather than a gradual change is advantageous.

Feeding cost is one of the major input costs of animal rearing. Thus, efficient scientific feeding may help to lower down the overall feeding cost. In contrast of entire lactation period which is around 275-285 days in cattle and >300 days in buffalo, quantity and quality of milk are highly variable. Thus, phage wise feeing exactly on the basis of quantity and quality may enhance the productivity and declines the feeding cost. Phase feeding guidelines (Table 3) were published by national research council-1989 & 2001 for the efficient feeding of dairy cows.

Table. 3: Nutrient guidelines for lactating dairy cows

Variables	Early Lactation	Mid Lactation	Late Lactation
Average milk yield (kg/day)	40	30	20
Dry matter intake (kg/d)	24-26	21-23	11-12
Crude protein (%DM)	17-19	15-16	13-15
Rumen undegradable protein (%CP)	35-40	30-35	25
Soluble protein (%CP)	25-33	25-36	25-40
Neutral detergent fiber (%DM)	30-34	30-38	33-43
Acid detergent fiber (%DM)	19-21	19-23	22-26
Effective fiber (%NDF)	25	25	25
Net energy for lactation (Mcal/kg)	1.64	1.57	1.5
Non-fiber carbohydrates (%DM)	30-42	30-44	30-45
Total digestible nutrients (%DM)	72-74	69-71	66-68
Fat (maximum in DM)	5-6	4-6	3-5
Ca (%DM)	0.8-1.1	0.8-1.0	0.7-0.9
P(%DM)	0.5-0.9	0.4-0.8	0.4-0.7
K(%DM)	0.9-1.4	0.9-1.3	0.9-1.3
Na (%DM)	0.2-0.45	0.2-0.45	0.18-0.45
Cl (%DM)	0.25-0.30	0.25-0.30	0.25-0.30
S (%DM)	0.22-0.24	0.20-0.24	0.20-0.22
CO (mg/kgDM)	0.2-0.3	0.2-0.3	0.2-0.3
Cu (mg/kgDM)	15-30	15-30	12-30
Mn (mg/kgDM)	60	60	50
Zn (mg/kgDM)	80	80	70
I2 (mg/kgDM)	0.8-1.4	0.6-1.4	0.6-1.2
Fe (mg/kgDM)	100	75-100	50-100
Se (mg/kgDM)	0.3	0.3	0.3
Vitamin A (1000 IU/day)	100-200	100-200	100-200
Vitamin D (1000 IU/day)	20-30	20-30	20-30
Vitamin E (IU/day)	600-800	400-600	400-600

Source NRC, 1989, 2001

Management of dry animals

Animals supposed to have 1.5-2.0 months non-productive period between the cessation of lactation and next conceive is termed as dry period. And such dry period is determined through the date of calving. During dry period and extreme last lactation period, the animal tries to re-condition the body conditions and especially uterine conditioning. During such period, body weight is conditioned (enhancing or declining) through optimum roughage concentrate allowance in total mixed ration, through enhancing concentrate allowance in thin animals and vice-versa. Dry animals may keep in isolated shed or with heifer shed. There must be the provision of ample exercise for dry animals, which enhance uterine motility and ultimately evacuation of uterine debris. Body condition score based feeding strategies should apply on dry animal feeding. Generally dairy owners compromise feed quality and quantity during dry period. Even though, such phage is important preparatory phage for the next term of pregnancy. Thus, such 1.5-2.0 months period must be nutritionally adequate so that the chances of next term may enhance.

Conservation of feed resources and processing to enhance the feeding sustainability of dairy farm

Conservation and processing of feed resources is one of the important tasks behind the sustainability of any dairy farm. Two possible outcomes through the implementation of such strategies are the year round availability of green fodder and other thing is, extracting more and more nutrients from the available feed resources. Green fodder availability is not consistent throughout the year. Even though, surplus quantity of green fodder is available during Rabi season (between October- February). However, scarcity occurs during the Khareef season (July-September) Zayad season (March-June). Thus, the year round balanced is tough task and without conservation of green fodder, such things impossible one. To make sure year round availability of green fodder, hay preparation, silage preparation is easy and commercially implementing methods.

Silage is, preserved anaerobic fermented succulent form of green fodder. Pastoral community may precisely understand the silage preparation is more or less similar to pickles or murabba preparation of fresh fruits. Excellent quality silage may be manufactured by maize, sorghum, pearl-millet, oats, perennial grasses (hybrid napier grass, guinea grass, para grass, sudan grass, rhode grass), leguminous fodder are not efficient for silage preparation. Even though, suitable combinations of leguminous fodder with non leguminous fodder may be utilized for silage preparation. For silage preparation, neither immature nor over matured crop is considered. However, crop having maximum nutrient content and comparable dry matter (30-35%) is considered for silage preparation. In maize, jowar, oats, flowering to milk stage is considered as the best stage of crop for silage preparation. Bajra, teosinte is best harvested at blooming stage. Hybrid napier, guinea grass best harvested at 1.25mt height stage. Silage is prepared through, chaffed fodder tightly packed in "Silos". Silos may be pit silo, tower silo, trench type silos. Pit silos is most common form of silos used for silage preparation and (3.0×2.5×2.0) meters dimensions of pit may be sufficient one for five dairy animals @ 20 kg silage per head per day for three months. Pit, preferably of circular type is plastered inner side and crops are chaffed in small pieces (>4 cm size). If the leguminous crops is available for silage preparation, mixed with non-leguminous crops, such as maize, jowar (@ 80-100 kg per ton of ensiled material) or molasses (@ 40-50 kg per ton of ensiled material) for the availability of measurable quantity of soluble carbohydrates. If the immature crop is available for silage preparation, wilted it before packing in pit. Some preservatives like, common salt (18-20 kg per ton), sodium metabisulphite (5 kg per ton), dilute acetic acid (10 kg per ton) or phosphoric acid (6 kg per ton) are added to enhance the fermentation mode and enriched the quality of silage. After filling the ensiled material with preservatives, the next step is thoroughly packing of pit through its entire dimensions by plastic sheet and layering of cow dung. Completely air tight conditioned should insure up to the complete preparation of silage (around 45 days). Prepared silage is rich in Vitamin A, better palatability then hay or dry roughage and highly reduced anti nutritional factors. Initially silage feeding not preferred by animals due to its taste, but gradual replacement of 10-15% fodder with silage may adopt the animal for silage feeding. After full adaptation for silage feeding, 20-30 kg silage with other traditional fodder may be implemented for feeding of animals.

Likewise silage, hay is one alternative fodder conservation method for lean period. Hay is made mainly by the sun drying of grass and other forage crops. After the crops has been cut, its treatment in the field is intended to minimize the losses of valuable nutrients caused by the action of plant respiration, by microorganism, by oxidation, by

leaching and may be by mechanical means. The nutritive value of hay is determined by the growth state and plant species of the parent crop, by field losses of nutrients and by changes taking place during storage (which can be reduced by the use of chemical preservatives). Even under good conditions overall losses of dry matter may be about 20%. Artificial dried forages are higher in nutritive value than hays. But they are expensive to procure and may be given to non ruminant livestock as source of mineral and vitamins. Berseem, Lucerne is cut in pre blossom stage for conservation, as it insure maximum protein and energy for hay. Fresh fodder is chopped (5-8cm cuts) for hay preparation. Chopped fodder is spread (not more than 15cm height) on the ground for direct sun light exposure. Regular turning of drying material enhances the rate of hay preparation. Extent/speed of hay preparation depends upon frequency of turning, intensity of sun light, air movement, nature of fodder used for hay making etc. prepared hay has comparable nutritive value as green fodder and able to year round feeding of animals. Thus may help to enhance the productivity and sustainability of dairy farm.

Animal's ration consists of roughage, concentrate and feed additives. Former provides the bulk to the ration. However, its available nutrient contents are sub-normal. Thus, by using various physical, chemical, physic chemical and biological methods owners may extract maximum nutrients through available inferior nutritive value roughage feed stuffs. By any physical means, such as soaking, chopping, grinding, pelleting, wafering, steam under pressure etc may adopted to enhance the nutritive value of roughage type feed stuffs. Using various alkali chemicals such as, NaOH, $Ca(OH)_2$, KOH, NH_4OH, NH_3, NH_3 Urea etc. may enhance the available nutrient content in roughage. Some acid chemicals such as, H_2SO_4, HNO_3 may also use for enrichment. Some Na salt and oxidizing agents like H_2O_2, O_3 may also useful for improving the nutritive value of feed stuffs. Combinations of above mentioned physical and chemical methods such as, use of NaOH with pelleting or steam treatment may also implement for quality enrichment of roughage. Some rot fungus, mushrooms may also useful for quality enrichment of inferior quality of roughage.

Immunization at dairy farm

Like human being, animals are also susceptible for various diseases. Thus, to sustain the farm productivity, vaccination (Table 4) is quite important and frequently using strategy. Before doing individual or mass vaccination, following points should considered

Health status: Before starting of individual or mass vaccination program, have to insure the health status of animal, as the readymade immunogens may create deleterious effects on animal's well-being.

Stress: Any kind of stressful conditions (either due to intrinsic stressors or external stressors), suppress the immune status of animal and vaccination on immune-suppressed animal create negative impact on health status of animal.

Deworming: Before starting of vaccination, deworming should performed 1-2 weeks prior.

Vaccination schedule: Dairy owners should strictly follow the vaccination schedule of animal, starting from birth by any veterinary expert.

Record keeping: date of birth of animal and its entire ancestry record should be maintained for better implementation of vaccination/ deworming protocol. Apart from it, the vaccine specifications such as manufacturing company, batch no of vaccine, expiry date of vaccine, dose and route of vaccine. Thus, dairy owners must appoint eligible employee to maintain such type of dairy record.

Cold chain: to maintain the potency of vaccine, its cold chain should be strictly maintained. Thus, dairy owners must have the provision of refrigeration.

Table. 4: Vaccination protocol at dairy farm Table.4 Vaccination protocol at dairy farm

Name of Disease	Age at first dose	Booster dose	Subsequent dose
Foot and Mouth			
Disease (FMD)	4 months and above	1 month after first dose	Six monthly
Haemorrhagic Septicaemia (HS)	6 months and above	-	Annually in endemic areas.
Black Quarter (BQ)	6 months and above	-	Annually in endemic areas.
Brucellosis	4-8 months of age		
(Only female calves)	-	Once in a lifetime	
Theileriosis	3 months of age and above	-	Once in a lifetime. Only required for crossbred and exotic cattle.

Anthrax	4 months and above	-	Annually in endemic areas.
IBR	3 months and above	1 month after first dose	Six monthly (vaccine presently not produced in India)
Rabies (Post bite therapy only)	Immediately after suspected bite.	4th day	7, 14, 28 and 90 (optional) days after first dose

Source : NDDB Handbook of Good Dairy Husbandry Practices

Influences of heat stress on dairy farming and its mitigation

To achieve a good productive response from dairy farming, owners should critically monitor the reproductive and physiological health status of animals. In dairy farming, heat abatement is burning issue. Heat effect influences various ill-effects such as, decrease dry matter intake, mount negative energy balance and increase calving-conception interval. Such type of reproductive disorders may deleteriously affect the productivity of dairy animals as well as on economic profit. Various experimentations have been suggested negative impacts of heat stress on dairy animal's productivity. Various others negative impacts of heat stress on reproductive performance of animal have been studied such as, poor oocyte, poor follicular diameter, and poor expression of estrous sign etc.

For the sustainability and profitability of dairy farm, various manage-mental, biotechnological and physiological practices may be applied to enhance the reproductive performance such as lower age at first calving, good oocyte quality, good sperm quality excellent libido of male bulls, good estrous expression, good ovarian activity etc. these conditions may be more improved if we reduced the heat stress conditions in dairy farm.

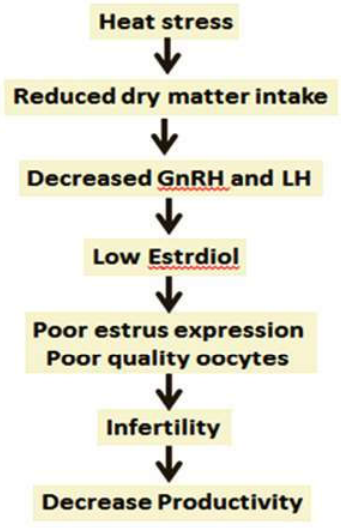

Fig. 2: Flow chart showing the effect of heat stress on productivity.

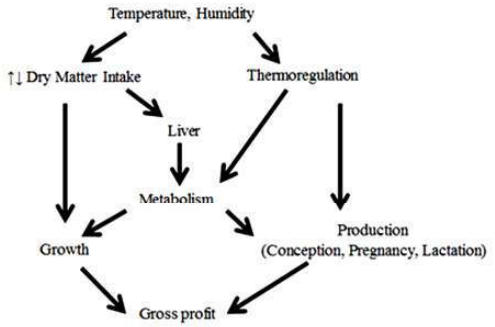

Fig. 3: Inter-relationship of factors affecting gross profit of dairy farm.

Strategies to prevail over heat stress

Many studies have shown the deleterious effects of stressors on productivity of dairy farm mainly due to impaired or mis management of environmental conditions such as impaired humidity, improper ventilation of housing, direct exposure of animal to sunlight for a longer time of the day. Controlled environmental temperature and humidity prevent or avoid the heat or cold stress and heat exchange between dairy animals (Amaral *et al*., 2009). Evaporation (through sprinkling) is the best method for cooling and wetting the dairy animals and enhances the convection heat transfer (Renaudeau *et al*., 2012). Housing management is the key factor to get rid of heat stress condition during longer day time. Feed and water should be kept under shade and this is cost effective management for heat abatement (Kamal *et al*., 2018). Material used for shedding should be waterproof, good heat conductor, moisture leak proof etc. (Kamal *et al*., 2018).

Various experiments suggested that elevated temperature restricts the embryonic growth due to some deleterious free radicals enter in the blood during longer time exposure to heat. Hence, some dietary supplementation like vitamins, minerals, feed additives are used to lower down the deleterious effect of free radicals in the body. A study reported that supplementation of vitamins and mineral to the transition animals enhance the milk production (Khorsandi *et al*., 2016). Zinc supplementation has inverse effect on heat shock

protein correspondingly also enhance the immunity of animal against heat shock (Sheikh *et al*., 2017).

To enhance the fertility in Dairy animals

To enhance the fertility of dairy cows first we should have to decrease any disease impact. A good metabolic health of a dairy cow helps to minimizing the clinical and subclinical diseases occurs during calving (Santos and Ribeiro, 2014). Thus, after calving some metabolic disorder creates negative energy balance in dairy animal. A very common condition Such as ketosis during pre partum and post-partum due to lipid breakdown into non esterified fatty acids then after these fatty acids breakdown into intermediate products in the form of ketone bodies and accumulates in the blood that progressively rises results in energy deficiency (Dyk and Emery, 1996). This high concentration of fatty acids circulating in the blood plasma occurs mainly during the initiation of lactation which may create another metabolic condition such as hepatic lipidosis.

Therefore to reduce such conditions and well-being of productive performance metabolic controlled actions required for the impaired concentrations of fatty acid and b-hydroxybutyrate in the blood (Raboisson *et al*., 2014). Dry matter intake decreased after post partum. So increased the dry matter intake of feeding modulation after post-partum have an inverse effect on negative energy balance which promotes the plasma concentration of glucose, insulin, growth factor like IGF-1, growth hormone etc. these promoted concentrations have direct favoring effect on hypothalamic-pituitary axis and the ovaries even after calving (De Rensis and Scaramuzzi, 2003).

Synchronization protocol

Management of reproductive cycle of dairy animal to short out the problem of estrous detection error by applying herd estrous synchronization at a permitted time. Different Researchers has been conducted different estrous synchronization protocols such as progesterone injections or a Progesterone Releasing Intra-vaginal Device PRID [Progesterone Release Internal Device] (Walsh *et al*., 2008), CIDR (Control Internal Drug Release) etc.. CIDR is a 'T' shape synthetic progesterone device, this CIDR protocol is one of the most reliable, successful protocol for estrous synchronization. These estrous synchronization protocols also enhance the health of reproductive tract, decrease the calving interval, increase new born, and milk production of the farm. Sometimes these protocols are also helpful in diagnosis and treatment of genital diseases.

Some products used for synchronization and their commercial name i.e. GnRH- Factrel, Fertagyl, OvaCyst Prostaglandin- In-Synch, Lutalyse, Lutalyse HighCon, ProstaMate, Progestin- CIDR (progesterone) etc. these protocols are used in the field, research area by many reproductive researcher, veterinarians, and experts in organizations.

(i) CIDR-PG protocol.

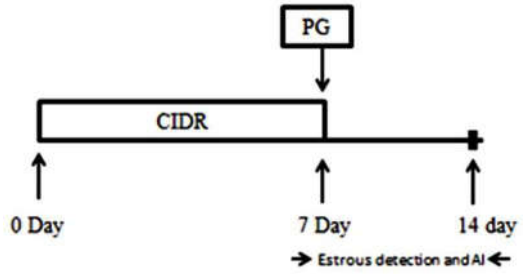

Fig. 4: CIDR and PG synchronization protocol

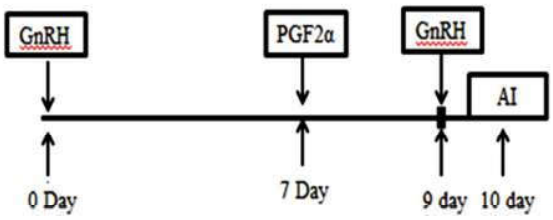

Fig.5 GnRH and PGF2α synchronization protocol.

Timely AI and pregnancy diagnosis

Artificial insemination technique is most commonly, cost effective and bearable to farmers to short out the poor genetic problems and decrease transferable venereal diseases from dairy animal. Use of this technique becomes more easy and possible when researchers, extension officer, veterinarians, and AI organizations cooperate with each other and pool their skill in this area to evaluate a successful scheme in the dairy sector to improve the economy. Physiologically proper hormonal balance during estrous cycle may control timed artificial insemination (TAI) in dairy animal. The most important thing is that correct Estrus detection for actual Artificial insemination. Some of estrous synchronization Protocols are suggested by many researchers to recognize and enhance the follicle growth, corpus luteum regression and ovulation to

permitting Timed Artificial Insemination.

Pregnancy diagnosis

Pregnancy is one of the most critical phases of animal's life. An accurate and early pregnancy diagnosis is more important as it helps in identification of non-pregnant animals which can be treated or rebred at the earliest part, reduce waste in a breeding programme by using expensive hormonal techniques, prevent lapse of one season for breeding in seasonal breeders etc. Pregnancy status of animals can be assessed by two ways i.e. direct methods and indirect methods. Direct assessment of pregnancy can be performed by per-rectal palpation and ultrasonography (USG). However, indirect assessment of pregnancy can be performed by progesterone assay, early conception factors, estrone sulphate, interferon tau and pregnancy associated glycoproteins (Balhara et al., 2013).

Per-rectal palpation of pregnancy diagnosis may be performed beyond 30days of geastation by palpation of amniotic vesicles and slipping of chorioallantoic membranes (Wisnicky and Cassida, 1948). However, accurate diagnosis may be achieved from 45days onwards (Arthur, 1966). Ultrasonography gives accurate, documentable and ultra-rapid technique for pregnancy diagnosis. Pregnancy diagnosis can be beyond 21day of pregnancy through heartbeat of developing fetus (Sharma et al., 2011). But it requires experience and high cost of technology. Using such technique is very important to detect the pregnancy days in pictorial record (day 28 of pregnancy) and also to determine developmental stage and defective condition of early growing fetus in pregnant uterus (Crowe et al., 2018). This technique is also useful in male dairy animal to detect testicular function and any abnormality.

Indirect method Progesterone can be detected in milk and plasma, its assay confirms non-pregnant status of animals by determination of its concentration after 21days of insemination (Perera et al., 1980). Early conception factors are proteins, those can be detected in serum in between 6-12 hrs of fertilization and it can be determine by rosette inhibition test. Even though it is very early pregnancy diagnosis tool, but early test may still remain low due to high incidence of losses during 1st 15days of conception (Ayalon, 1978). Estrone sulphate is a conjugated steroid product of estrone, which is present in bovine placentome (Eley et al., 1979) and diagnoses the pregnancy beyond 52 day and up-to end of gestation. It is not an ideal bio-marker of pregnancy as its concentration may provoke by some other factors such as, genetic and environment factor (Lobago et al., 2009).

Biotechnological methods

To enhance the herd performance of a well organized dairy farm, some biotechnological methods are very helpful. These techniques are frequently in use since last century to improve herd reproductive quality (Roche *et al*., 2018). In an organized herd the main problem are human error and lack of diagnostic knowledge of reproductive conditions such as service, calving interval, lactation period and gestation period. A study shown that use of these bio-technological methods, such conditions fixed time artificial insemination (FTAI) can be minimized without going through estrous detection (Colazo and Mapletoft, 2014).

Various reproductive bio-techniques are emerging all over the world to overcome the reproductive problems and human error through manual methods. From last four decade a fruitful technique is progressed that is In Vitro fertilization (IVF) to treat the infertile animals, sexed semen technology (to achieve more female calves). In this In Vitro fertilization (IVF), a genomic selection of super donor and super recipient animals done for the collection of egg from super donor female and sperm from duper male. After selection and collection of gametes from both male and female, gametes are fertilized in the well-organized In Vitro fertilization laboratory to develop embryos. Then these embryos combined with sexing technologies. After fertilization, the 8 cell stage of embryo transfer to super recipient female for rest developmental stage of embryo in the uterus called (In Vivo). Transfer of embryo from In vitro stages to super female by technique called embryo transfer technique. This is a developed nonsurgical breeding technique for transferring embryos (Foote and Onuma, 1971).

Conclusion

For successful dairy entrepreneur, sustainable productivity/profitability are most important considerations. Dairy needs lots of investment either small level establishment or leading dairy. Animal's age wise requirements and year round availability of feed ingredients varies drastically. Thus, scientifically meeting the requirements and utilization of available feed resources in more efficient ways may influence the sustainability of dairy enterprise. Sufficient eco-friendly infrastructure of dairy farm, efficient and dedicated

dairy staff for running the farm, various records keeping of farm, consultancy of expert veterinarian for treatment/ prevention and control of diseases strengthens the dairy farm.

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