2021

Edition

Good Animal Husbandry and Veterinary Practices for Doubling of Farmers' Income

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Programme Coordination

Veterinary College, Karnataka Veterinary, Animal and Fisheries Sciences University, Gadag, Karnataka

Jointly Published By

Veterinary College, KVAFSU, Gadag

&

MANAGE, Hyderabad

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Edition: 2021.

ISBN: 978-93-91668-57-0

Citation: Nagaraja, R., Shahaji Phand, Shivakumar K. Radder. (2021). *Good Animal Husbandry and Veterinary Practices for Doubling of Farmers' Income* [E-book]. Hyderabad: National Institute of Agricultural Extension Management & Veterinary College, Karnataka Veterinary, Animal and Fisheries Sciences University, Gadag, Karnataka.

This e-book is a compilation of resource text obtained from various subject experts of Veterinary College, KVAFSU, Gadag & MANAGE, Hyderabad, on "Good Animal Husbandry and Veterinary Practices for Doubling of Farmers' Income". This e-book is designed to educate extension workers, students, research scholars, academicians related to veterinary science and animal husbandry about the good animal husbandry and veterinary practices for doubling of farmer's income. Neither the publisher nor the contributors, authors and editors assume any liability for any damage or injury to persons or property from any use of methods, instructions, or ideas contained in the e-book. No part of this publication may be reproduced or transmitted without prior permission of the publisher/editors/authors. Publisher and editors do not give warranty for any error or omissions regarding the materials in this e-book.

Published for Dr.P.Chandra Shekara, Director General, National Institute of Agricultural Extension Management (MANAGE), Hyderabad, India by Dr.Srinivasacharyulu Attaluri, Program Officer, MANAGE and printed at MANAGE, Hyderabad as e-publication.

MESSAGE

National Institute of Agricultural Extension Management (MANAGE), Hyderabad is an autonomous organization under the Ministry of Agriculture & Farmers Welfare, Government of India. The policies of liberalization and globalization of the economy and the level of agricultural technology becoming more sophisticated and complex, calls for major initiatives towards reorientation and modernization of the agricultural extension system. Effective ways of managing the extension system needed to be evolved and extension organizations enabled to transform the existing set up through professional guidance and training of critical manpower. MANAGE is the response to this imperative need. Agricultural extension to be effective, demands sound technological knowledge to the extension functionaries and therefore MANAGE has focused on training program on technological aspect in collaboration with ICAR institutions and state agriculture/veterinary universities, having expertise and facilities to organize technical training program for extension functionaries of state department.

Animal husbandry is an integral component of Indian agriculture supporting livelihood of more than two-thirds of the rural population and also plays various roles in the growth and development of national economy through entrepreneurship opportunities which increases the income level and employment opportunities in rural as well as urban areas.. The veterinarian is committed professionally and morally with the rural community. Veterinary professionals disseminate their knowledge to the community as a whole to improve the quality of life. In our country, veterinary service literally means the difference between life and death not only for animals but also for humans as majority of our poor population depends on animals for food, income, social status or cultural identification, companionship, security, where there is nothing more important than taking care of the animals that allow adults to work, families to earn and children to eat. But this sector is not free from challenges; most serious issue in this sector is regional disparity. Hence first of all in order to fulfil the dream of doubling farmer's income there is need to eliminate this regional disparity through awareness practices among the farmers.

It is a pleasure to note that, Veterinary College, Karnataka Veterinary, Animal and Fisheries Sciences University, Gadag, Karnataka is organizing a collaborative training program on "*Good Animal Husbandry and Veterinary Practices for Doubling of Farmers' Income*" from 20-22 January, 2022 and coming up with a joint publication as e-book on "Good Animal Husbandry and Veterinary Practices for Doubling of Farmers' Income" as immediate outcome of the training program.

I wish the program be very purposeful and meaningful to the participants and also the e-book will be useful for stakeholders across the country. I extend my best wishes for success of the program and also I Veterinary College, Karnataka Veterinary, Animal and Fisheries Sciences University, Gadag, Karnataka, many more glorious years in service of Indian agriculture and allied sector ultimately benefitting the farmers. I would like to compliment the efforts of Dr. Shahaji Phand, Centre Head-EAAS, MANAGE, Hyderabad Dr. R. Nagaraja, Dean, Veterinary College, Gadag for this valuable publication.

Dr. P. Chandra Shekara
Director General, MANAGE

PREFACE

India is an agrarian country. Majority of the people of the country are directly or indirectly dependent upon agriculture as their main source of income and employment either in principal or subsidiary form. Animal Husbandry is an important component of agricultural system of our country. Majority of the farmers in our country practice mixed farming system where in livestock plays and important role. India has the largest population of livestock in the world. Cattle and buffalo constitute over half of the livestock population. As such, dairy farming is the backbone of livestock sector and agricultural GDP. Evidence suggests that distribution of livestock among farmers is more equitable as compared to land. Besides, it presents opportunity for entrepreneurship in processing, value addition and feed manufacturing. Over a period of time, where in land holdings are fragmented and increase in agricultural production appearing to approach saturation, animal husbandry appears as a promising enterprise to increase income of farmers. In this regards, veterinary science plays an important role in treatment of diseased animals, maintenance of health and production of livestock and also augmentation of productivity in livestock. Of late, a dream target of our Hon'ble Prime Minister Shri Narendra Modiji towards doubling of farmers income has gained momentum. This doubling of farmers' income is to be achieved through various means. Present deliberation is an attempt to throw light on role played by animal husbandry sector and veterinary science in doubling of farmers income. The topics have been carefully selected to offer possible guidance with regard to practices to be followed in animal husbandry and veterinary sciences for enhancing production and income. This book was made possible by the sincere efforts of the contributing authors.

This e-book is an outcome of collaborative online training program on "Good Animal Husbandry and Veterinary Practices for Doubling of Farmers' Income" conducted from 20-22 January, 2022. This book will be highly useful to field functionaries as well as extension workers who are working at the ground level. A myriad of topics from role of - animal husbandry, alternate feeding strategies, reproductive technologies, animal biotechnology, livestock management practices – in doubling farmers' income has been covered for the benefit of the readers.

The editors express sincere thanks to Prof. H.D. Narayanaswamy, Hon'ble Vice Chancellor, KVAFSU, Bidar, for encouragement in publishing this e-book. The financial aid provided by MANAGE, Hyderabad for this training program is duly acknowledged. We hope and believe that the suggestions made in this e-book will help to improve the ability of all the stakeholders to enhance livestock production in support of doubling of farmers' income.

January, 2022

Dr. R. Nagaraja
Dr. Shahaji Phand
Dr. Shivakumar K. Radder

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Introduction

India is an agrarian country. Majority of the people of the country are directly or indirectly dependent upon agriculture as their main source of income and employment either in principal or subsidiary form. Animal Husbandry is an important component of agricultural system of our country. Majority of the farmers in our country practice mixed farming system where in livestock plays and important role. Over a period of time, where in land holdings are fragmented and increase in agricultural production appearing to approach saturation, animal husbandry appears as a promising enterprise to increase income of farmers. In this regards, veterinary science plays an important role in treatment of diseased animals, maintenance of health and production of livestock and also augmentation of productivity in livestock. Of late, a dream target of our Hon'ble Prime Minister Shri Narendra Modiji towards doubling of farmers income has gained momentum. This doubling of farmers' income is to be achieved through various means. Present deliberation is an attempt to throw light on role played by animal husbandry sector and veterinary science in doubling of farmers income.

Farmers' Income - Farm households earned Rs. 77,888 in the period from July 2012 to June 2013 or INR 6491 per month during this period. During the same period from 2002 to 2003 the earning of the farm households, based on a similar survey by NSS, was INR 2,115 per month. This translates to a CAGR of 3.4% for real household incomes during the period from 2002-03 to 2012-03. CAGR for real income from crop cultivation, income from livestock, income from nonfarm business and income from salaried/wage employment for the same period turns out to be 3.7%, 14.3%, -0.1% and 1.4% respectively. The growth of income from livestock was very high compared to other incomes and it has increased its share in total income of a farm household from 4% to 13%. (Ranganathan, 2014).

Doubling of Farmers' Income: Past strategy for development of the agriculture sector in India has focused primarily on raising agricultural output and improving food security involving (a) Increase in productivity (b) incentive structure in the form of remunerative prices for some crops and subsidies on farm inputs; (c) public investments in and for agriculture; and (d) facilitating institutions. The strategy did not explicitly recognise the need to raise farmers' income and did not mention any direct measure to promote farmers' welfare.

While talking about income of the farmers in a Kissan Rally in Bareilly, Uttar Pradesh, on 28th February, 2016, the Prime Minister stated that it is his dream to see farmers double their income by 2022, when the country completes 75 years of its Independence. requiring an annual growth rate of 10.4 per cent. (Chand, 2017).

Strategy for Improving Farmers' Income

The sources of growth in output and income can be put in four categories (i) development initiatives including infrastructure, (ii) technology, (iii) policies and (iv) institutional mechanisms.

Roadmap and Action Plan: Quantitative framework for doubling farmers' income -

(i) Increase in productivity of crops
(ii) Increase in production of livestock,
(iii) Improvement in efficiency of input use (cost saving)
(iv) Increase in crop intensity
(v) Diversification towards high value crops
(vi) Improved price realization by farmers
(vii) Shift of cultivators to non-farm jobs and

Animal Husbandry & Economy : Total Value Output from Livestock Sector was Rs. 11,59,636, during the year 2018-19. Livestock sector contributes 4.11% GDP and 25.6% of total Agriculture GDP.

Table 1. Livestock Population in India

Category	Population (In million) 2019	% growth over previous Livestock Census
Cattle	192.49	0.83
Buffalo	109.85	1.06
Sheep	74.26	14.13
Goat	148.88	10.14
Pig	9.06	-12.03
Mithun	0.38	26.66
Yak	0.06	-25.00
Horses & Ponies	0.34	-45.58
Mule	0.08	-57.09
Donkey	0.12	-61.23
Camel	0.25	-37.05
Total Livestock	535.78	4.63

Source : 20th Livestock Census – 2019, All India Report, Dept. of Animal Husbandry & Dairying, GOI.

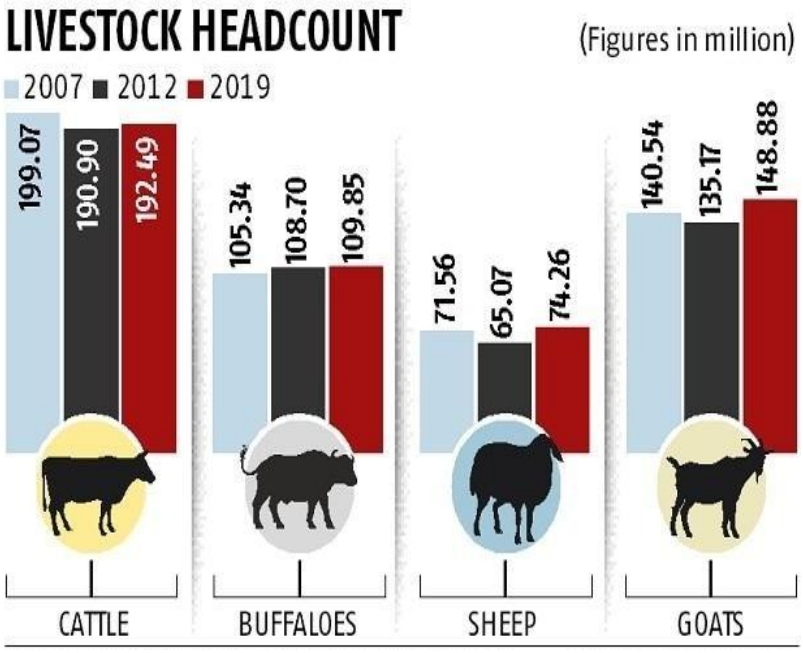

Table 2. Animal Products Statistics in India – 2018-19

Commodity	Total Production (per year)	Per Capita Availability	ICMR Recommendations
Milk	176.3 MT	375 grams/day	280 grams/day
Meat	7.7 MT	2.96 kg/year	11 kg/year
Eggs	95.2 billion	74 eggs/year	182 eggs/year
Wool	41.5 million kg	–	–

Table 3. Value of Output from Livestock sector - At current prices (in Rs. Crore)

Item	2012 – 13	2018-19
Milk Group	3,72,228	7,72,705
Meat Group	1,14,995	2,42,629
Eggs	19,690	36,691
Wool & hair	539	745
Dung	40,453	65,383
Silk Worm Cocoons and Honey	4,947	10,036
Increment in Stock	12,086	31,447
Value of Output from Livestock Sector	**5,64,937**	**11,59,636**

Source : National Accounts Statistics-2018, Central Statistical Organisation, GoI

Role of A.H. & V.Sc. in Doubling Farmers' Income:

Animal Husbandry Plays an important role in doubling of farmers income. This can be realized in following ways.

1. Potential of Animal Husbandry regarding adoption of novel technologies to enhance production and income as compared to saturating crop production sector.
2. Emergence of a new field of pet animal rearing – Helps farmers breed pets and sale.
3. Expanding network of veterinary colleges, universities, institutes in strengthening of effective veterinary services delivery and extension education.
4. Increased importance given by central and state governments to secure rural livelihoods through animal husbandry.
5. Emerging networks of SHGs. Majority are Women Run. Animal Husbandry is predominant occupation.

6. Intensification methods followed in animal husbandry.
7. Use of ICTs for – Faster technology dissemination, marketing information etc. This is leading to fast expected growth rate in animal husbandry sector.
8. Building up upon growing trends of health consciousness towards organic and desi livestock products and consequent demands to such products provides niche opportunity to farmers to increase their income.

9. Integrated farming system (IFS) is another key technique for increasing farm family income in a reasonable amount of time. As a result, training farmers in the Integrated Farming System (IFS) is crucial. (Ponnusamy & Devi 2017)

Chand (2017) of NITI Ayog noted that Productivity of livestock is quite low in the country. Average milk yield is 4.90 kg per in-milk buffalo and 3.1 kg per in-milk cow. It is estimated that about 37 per cent growth in milk output has been due to increase in productivity of in-milk population, and, increase in number of livestock is the dominant source of growth in milk output (Birthal et. al. 2006). This type of growth associated with increase in population of livestock is not sustainable. Breed improvement, better feed and nutrition, animal health, and better herd composition are important measures for raising livestock productivity. In terms of development initiatives following targets are suggested by 2022-23:

- In India, coverage under Artificial Insemination (AI) in cattle and buffaloes is hardly 35%. The main reason for low artificial insemination is semen straws. We require 160 million doses of semen straw against current availability of 81 million to reach reasonable level of Al.

- Presently about 4 million breedable buffaloes, 1.3 million breedable cross bred cattle and 6 million breedable indigenous cattle have never calved. Out of above population, at least 2 million buffaloes, 0.8 million crossbred and 3 million indigenous cattle should have additional number for calving by 2020.

- Age of buffaloes at puberty has to be reduced by 3-4 months by 2020. At present, the puberty age of murrah buffaloes is about 33 months.

Hence, improvement in herd quality, better feed (better feeding management/better nutrition), increase in artificial insemination, reduction in calving interval and lowering age at first calving are the potential sources of growth.

About one third of the increase in farmers' income is easily attainable through better price realization, efficient post-harvest management, competitive value chains and adoption of allied activities. This requires comprehensive reforms in market, land lease and raising of trees on private land. Agriculture has suffered due to absence of modern capital and modern knowledge. There is a need to liberalise agriculture to attract responsible private investments in production and market. Similarly, FPOs and FPCs can play big role in promoting small farm business. Ensuring MSP alone for farm produce through competitive market or government intervention will result in sizeable increase in farmers' income in many states.

If concerted and well-coordinated efforts are made by the Centre and all the States and UTs, the Country can achieve the goal of doubling farmers' income by the year 2022.

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2. GOOD ANIMAL HUSBANDRY PRACTICES FOR DOUBLING FARMERS INCOME: EXPERIENCES OF FIELD BASED RESEARCH PROJECTS

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GOOD PRACTICES

"A good practice is simply a process or a methodology that represents the most effective way of achieving a specific objective. Some people prefer to use the term 'good practice' as in reality it is debatable whether there is a single 'best' approach – and of course approaches are constantly evolving and being updated. So, another way of defining a good practice is one that has been proven to work well and produce good results, and is therefore recommended as a model. The essence of identifying and sharing good practices is to learn from others and to re-use knowledge. The biggest benefit consists in well developed processes based on accumulated experience." (SDC, 2004)

Good practices in Extension and Advisory Services include:

- Application of ICTs
- Ways of reaching effectively women and socially excluded groups
- Linking farmers to markets
- Capacity Development
- Decentralisation of extension
- Financing of extension
- Role of Farmer Organisations
- Partnerships and Collaboration
- Addressing Nutrition through extension
- Pluralism and Co-ordination
- Extension Policy Development
- Adaptation to climate change

However, good practices in animal husbandry and dairy sector has been a critical element for improved production and productivity. Over the years, although various attempts are made to promote scientific practices in field conditions, there is a poor response from the farmers which might be due to major constraints like lack of awareness and inputs, poor socio-economic status of the farmers, cost of production, poor market access etc. Further, coordination among various stakeholders also plays a pivotal role in promoting good practices in animal husbandry sector for

sustainable livelihood. In this context, there is a need to undertake livestock based research and extension activities at field conditions for sustainable livelihood. This manuscript has focused on various participatory research and extension activities undertaken through different projects by different funding agencies and has discussed various strategies for development of animal husbandry sector of Karnataka. Some of the important activities discussed in this paper are based on following projects and few such relevant experiences of the authors.

- World Bank funded KWDP-II, Sujala-III project of Government of Karnataka
- ICRISAT, Patancheru based projects at Uttar Pradesh (Major state considered)
- ICAR, New Delhi-SCSP Project

Good Practices in Animal Husbandry- Major Experiences of Karnataka

The project is implemented through World Bank Funded Watershed Development Department of Government of Karnataka based on flow of water channels and socio-economic conditions. These activities are undertaken in seven project districts of Karnataka. The experience shared is from the project villages of the World Bank funded, Karnataka Watershed Development Department sponsored - Sujala III project, implemented by Veterinary College, Bidar from December 2014 till date. The study involved individual farmers and member farmers of producer organizations (for example: Karnataka Milk Federation, private milk societies etc.), State Dept. of AH&VS, State Dept. of Agriculture etc.

Based on baseline survey results, conducted by KVAFSU, Bidar in the project area, the production practices and critical gaps were identified in Animal Husbandry sector of Bidar District. To address the above mentioned critical gaps, technical interventions were introduced in consultation with the technical experts, field functionaries and farming community.

Methodology of the Study

- Purposive sampling technique was used for selecting Bidar district since Sujala-III project was implemented in this district by Veterinary College, Bidar.
- A baseline survey in 14 project villages as identified by Government of Karnataka (India) and various meetings/ awareness programmes in the project villages paved the way for creating knowledge and interest about different scientific practices at farmers' field.
- Depending on the baseline survey and critical gaps, various technical interventions were introduced in the project area.
    - Workshops/Awareness programmes on identified interventions and field day
    - On – Farm Demonstrations on Enrichment of dry fodder and usage of low quality unconventional feeds
    - On – Farm Demonstrations on Silage making by using silo bags
    - On-Farm Trials on Integration of fodder and fodder trees in horticulture crops on bunds of farm ponds. (Livestock with horticulture).
    - On-farm trials in feeding of goats during transition period
    - Participatory Research on Detection and control of subclinical mastitis

- Production Units- Establishment of fodder nurseries (Minimum of 5 varieties in 2 *guntas* each
- Production Units- Introduction of Rams/Bucks
- Production Units-Promotion of *Sesbania* as fodder for livestock

- Awareness programmes, trainings, field days and demonstrations about fodder production and its importance were conducted by the multi-disciplinary teams for the beneficiaries. A before-after research design was followed for the study to know the impact of these programmes in the project villages.
- Pre-exposure and post-exposure attitude tests, knowledge tests, and adoption studies were conducted in the project villages, focusing on the objectives of the scheme, before and after conducting the awareness and demonstration programme.

ESTABLISHMENT OF FODDER NURSERY FOR DAIRY DEVELOPMENT

The establishment of fodder nursery and distribution of fodder seeds/root slips among the farming community through integrated and participatory extension approaches is essential for dairy development.	
Good Practices Followed	**Benefits and Impact**
• Awareness programmes, trainings and demonstrations • Technical staff/Human resource: • Fodder Nursery and demonstration plot established • Access to inputs • Farm literature and video • Convergence of multi-stakeholders/ actors	• Increase in fodder production and farmers' interest • Horizontal diffusion of fodder production practices • Preference for fodder cultivation • Improved knowledge level of dairy farmers • Improved quantity and quality of milk • Improved economic returns • Promotion of suitable fodder variety • Silage making by beneficiary farmers

PREVENTION AND CONTROL OF SUB-CLINICAL MASTITIS (SCM) IN DAIRY ANIMALS

The convergence of multi-stakeholders, aimed at promoting integrated and participatory extension approaches, can achieve prevention and control of sub-clinical mastitis in dairy animals.	
Good Practices Followed	**Benefits and Impact**
➢ Convergence of multi-stakeholders ➢ Technical staff/Human resource ➢ Awareness programmes, trainings and demonstrations	➢ Change in perception of beneficiaries ➢ Improved knowledge level of dairy farmers ➢ Improved management practices

➢ Access to inputs ➢ On-farm trials ➢ Animal health care and treatment ➢ Farm literatures and video ➢ Advisory and technical support	➢ OFT on subclinical mastitis detection and prevention ➢ Prevention of economic losses

SUPPLEMENTARY FEEDING OF GOATS DURING TRANSITION PERIOD FOR IMPROVING PRODUCTIVITY

An integrated and participatory extension approaches is very critical in improving goat productivity through supplementary feeding during transition period.	
Good Practices Followed	**Benefits and Impact**
➢ Awareness programmes, advisory services and demonstrations ➢ Access to inputs ➢ Farm literature ➢ Convergence of multiple stakeholders/actors ➢ Participatory action research	➢ Improved knowledge level of beneficiaries and adoption ➢ Improved productivity ➢ Improved economic returns ➢ Prevention of economic losses ➢ Improved management practices

On farm demonstrations: Enrichment of dry fodder and use of quality unconventional feeds:

Crop residues are used as the most abundant livestock feeds and have a great potential as a feed stuff in India. In this context, to improve the value of such low-quality feedstuffs, enrichment using urea is considered as a potential option at field level. Although urea-treated straw is more palatable and digestible, this practice has its own limitations due to which it is not disseminated effectively to field conditions. This activity is taken up in the project villages using different residues like sugarcane trash, jowar straw, paddy straw etc.

On farm demonstrations: Silage making by using silo-bags:

Lack of green fodder availability during summer season was found to be one of the important problems faced by the farmers. Hence, silage making using silo bags was undertaken since this method has advantages compared to conventional silage making. Conventional system of silage making require water proof and air tight cement tanks which is costlier. Hence, reusable silage bags of different quantities are cheaply available and can be kept in different places. Different types of silo-bags are available with varying capacities viz., 2 quintals to 10 quintals. This method is suitable even to small holders. The farmers have adopted this practice of silage making using silo-bags in project villages.

Improving Dairy Productivity and Resource Use Efficiency in Bundelkhand Region of Uttar Pradesh

With the financial support of Government of Uttar Pradesh, ICRISAT has identified and created a consortium to undertake the expertise-based interventions in 20 pilot villages of seven districts in Bundelkhand region of Uttar Pradesh. The experience shared is from the project villages of this project implemented by ICRISAT Development Center, ICRISAT, Patancheru from May-June, 2017 till date. The study involved individual farmers, member farmers of different organizations, officers of State Dept. of AH&VS, State Dept. of Agriculture, BISLD and NGO partners.

Consortium partners in dairy development and their role clarity

Institute/Organization	Technical support/Interventions
BISLD, Allahabad	• Livestock productivity enhancement by breeding services and animal health care
ICAR-Indian Grassland Fodder Research Institute (IGFRI), Jhansi	• Availability of improved fodder seeds and its management practices • Undertaking FLDs • Capacity building/ trainings on improved fodder technologies
KVKs	• Capacity building of farmers on package of practices on various crop production technologies; and assist in convergence of programs at the village level
NGOs (Seven Nos)	• Community mobilization

Programme Design:

1. In May 2017, with the help of district administration and officers of department of agriculture, the pilot sites covering about 5000 hectare area (hydrological boundary) in all the seven districts were identified. A cluster of two to three villages were selected for developing the pilot site in each district.
2. A baseline survey of about 200 farmers from each district totaling to 1400 farmers from 20 selected project villages was carried out. The study included the status and issues in agriculture and animal husbandry practices faced by farming community.
3. Based on the baseline survey results, few issues like *anna pratha*, presence of low yielding dairy animals, poor access to veterinary and breeding services, lack of green fodder production etc. were identified as the critical gaps in dairy sector of Bundelkhand region.
4. To address the identified critical gaps, the concerned institutions/organization were identified and assigned the tasks as consortium partner in the project.
5. Between May, 2017 and June, 2018, ICRISAT worked towards building rapport directly with the community with the help of local NGOs. Meanwhile, ICRISAT formed the consortium of national level institutions as depicted in Table 1.

6. As experts in the animal husbandry sector, ICAR-IGFRI and BISLD also conducted a preliminary study dealing with dairy animal population, breedable population, types of animals reared, scope for SSS and EPD, fodder production status etc. in the project locations.
7. Depending on the critical issues identified, multiple dairy development interventions like SSS, EPD, animal health and infertility camps, capacity building programmes, green fodder production etc. were initiated by the project partners.
8. A before-after research design was followed with participatory research to know the impact of these programmes in the project villages.

Technology related Practices

1. Sex sorted semen (SSS) insemination at the farmers' door step
2. Early pregnancy diagnosis (EPD) at the farmers' door step
3. Animal health and infertility camps
4. Green fodder production
5. Establishment of rural biogas plants

Extension related Practices

1. Mobile enabled information delivery
2. Farm literature and video
3. Formation of farmer interest groups
4. Awareness programmes and capacity building
5. Human resource for implementation and monitoring

Benefits and Impact

The outcome or results of the interventions undertaken in the project locations require sufficient time to showcase the benefits and impact. However, an effort has been made to compile such benefits and impact observed till date in the project locations.

1. Increase in birth of female calves
2. Cost effective early pregnancy diagnosis
3. Improved green fodder production
4. Increase in milk production and improved economic returns
5. Utilization of animal wastes through rural biogas plants
6. Improved knowledge level and interest of dairy farmers

WAY FORWARD

Though the projects received poor response from the farmers initially, integrated extension approaches of consortium partners helped the project teams in improving the knowledge level and practicing the scientific technologies being promoted with very low investment. A policy shift emphasising delivery of inputs and regular follow-up for carrying out an integrated extension approach is very critical to enhance production and productivity.

In the existing scenario, the author realized that the good practice would be adopted easily if the farmers get an access to major inputs and services, knowledge about the practice, etc. Further, the farmers need to be motivated to undertake these interventions and create sustainability through participatory approaches even after the termination of the project. The project teams have also emphasized on formation of farmers interest groups for the sustainability of the project activities and create participatory involvement of the beneficiaries. Although the farmers have gained adequate knowledge and positive attitude towards dairy development, maintaining either formal or informal consortium approach among the partners is essential for few more years in such development based projects. However, in the long run, the integrated and consortium approach can be applied at a larger scale to promote livestock development or any such agricultural based development programmes for doubling the farmers income.

3. ALTERNATIVE FEED RESOURCES FOR AUGMENTING PROFITABILITY ON LIVESTOCK FARM

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Livestock in developing countries like India are the poor people's ATM. In good times people build up their herds and in bad times they sell livestock to generate cash. Livestock provides stability to family income especially in the arid and semi-arid regions of the country. Livestock are the best insurance against the vagaries of nature due to drought, famine and other natural calamities. Animals who survive from these calamities are threatened by non-availability of feed and shelter. Like other agricultural crops, fodder field are also completely destroyed. These feed deprived and shelter less animals are stressed and immune-suppressed, thus become susceptible to contagious diseases. Chronic feed deficits represent a major constraint to animal production. The livestock farmers do not have any alternative source of livelihood, can not reduce their numbers of livestock own, most of the low productive animals. Hence, steps must be taken to improve production through better utilization of available alternate feed resources. The available feed resources are primarily crop residues and other poor quality roughages and foraging materials. A number of alternative feed resources considered to be non-conventional feed resources have also been indentified and are now being utilized in animal ration. The non-conventional feed resources may have certain limitations and because of that these may not be palatable or poorly digestible or some time toxic to the animal. On the basis of their origin these can be divided into various categories.

1. Crop residues and newer feeds
2. Top feed resources
3. Agro-industrial by-products
4. Marine wastes, by-products and aquatic plants
5. Fruit and vegetable wastes

1. Crop residue and newer feeds:

Unconventional straws like soybean straw, sunflower straw and rapeseed/mustard straw, cotton straw, cotton seed hulls, sunflower heads, sugar cane bagasse, saw dust, wood pulp waste, forest dry grass and leaves, banana leaves, pineapple waste, maize cobs, groundnut hulls are used in ruminant diets. Moringa leaves, some fruit peels and some flower petals are used in poultry rations.

Table 1. Chemical composition (% on DMB) of some crop residues

Straw	DM	CP	EE	CF	NFE	Ash	ME (Mcal/kg)	Ca	P
Cereal straws								0.5-0.6	0.12-0.14
Rice straw	90	3	1	32	49	15	1.69		
Wheat straw	90	3	1	38	46	12	1.83		
Oat straw	90	4	1	36	52	6	1.5		
Ragi straw	90	3	1	36	52	8	2.0		
Jowar straw	90	5	1	34	50	10	2.0		
Maize straw	85	3.6	0.8	33	51.9	10.5	1.5		
Legume straw								1.0-1.4	0.08-0.15
Gram straw	90	6	0.5	45	36	13	1.6		
Groundnut straw/haulms	90	8	1	41	24	8	1.8		
Horse gram straw	90	10.6	1.2	44.8	38.1	5.3	1.7		
Hays									
Indigenous grasses	88	5	1	35	47	12	-	0.3	0.2
Improved grasses	88	7	1.5	30	51	10	-	0.35	0.25
Legumes	88	15	2	30	41	12	-	1.5	0.25

2. Top feed resources:

Trees and shrubs provide green biomass of moderate to high digestibility and protein contents. The DM content of top feed ranges from 20-40% with 10-15% CP on DMB. The palatability, digestibility and nutritive value of the tree leaves also decreases with advancing maturity. 300-350MT of dry fallen leaves and grass is available from the forest. These can be used in feed formulation for maintenance of sheep and for growth also (ADG-180-200g/day).

Table 2. Chemical composition (%) of tree leaves

Sl. No.	Plant name	CP	EE	CF	NFE	TA	Ca	P
1	*Acacia nilotica (Babul)*	13.90	-	9.20	69.80	7.10	2.60	0.10
2	*Acacia arabica*	15.00	5.06	20.10	51.62	8.22	1.50	0.19
3	*Albizia lebbeck(Bage)*	26.50	3.29	31.21	36.10	7.11	1.10	0.25
4	*Azardirachta indica (Neem)*	14.50	2.31	23.34	46.85	4.68	-	-
5	*Ficus bengalensis (Banyan)*	7.46	3.25	9.87	65.36	14.06	2.25	0.16
6	*Hardwichia binata(Anjan)*	8.98	4.05	30.39	49.69	-	2.28	0.13
7	*Leucaena leucocephala (Subabul)*	15.22	2.95	15.02	55.72	11.09	2.99	0.19
8	*Madhuca indica*	9.97	2.32	20.51	56.75	10.45	-	-
9	*Moringa oleifera(Nugge)*	15.60	4.40	17.90	48.70	13.40	-	-
10	*Morus alba(Mulbery)*	16.35	8.04	9.07	-	20.09	2.79	0.47
11	*Procopis juliflora(Banni)*	21.40	-	20.80	50.00	7.70	1.50	0.20
11	*Prosopis cineraria*	13.98	1.88	17.80	43.44	22.90	2.73	0.15
12	*Sesbaina grandiflora*	33.48	2.57	5.67	46.76	11.62	2.33	0.33
13	*Zizyphus nummularia*	14.25	4.34	15.73	57.12	8.56	2.43	0.14

3. Agro-industrial by-products:

These can be used up to 30-35% in ruminant feed. Incriminating or antinutritional factors present in these feeds reduce their nutritive levels and may affect production and reproduction adversely if recommended levels are exceeded. Therefore suitable treatments are to be given for removal of antinutritional factors. Cashew bran, neem seed cake, karanja cakes are used as non-conventional feed resources in livestock feeding.

Table 3. Nutritive value (% on DMB) of Agro-industrial By-products

Name	DCP	TDN	Level CFM (%)	Toxic factor
Apple waste	2.0	70.0	30	Nil
Ambadi cake	18.7	63.8	20	Nil
Babul seeds	13.8	59.0	30	Tannins(5%)
Cassava starch waste	1.8	64	25	Nil
Castor bean meal	-	-	10	Ricin(0.22%)
Coconut pith	0.0	62.7	25	Lignin(35-40%)
Tea waste(decaffeinated)	7.5	58.0	15%	-

Karanj cake	25.5	62.0	15	Karnanjine(10-15mg/100g cake)
Mango seed kernal	6.1	70.0	10	Tannins(5-6%)
Mahua seed cake	9.3	49.8	20	Mowrin(19%)
Niger seed cake	32.7	49.4	57	Nil
Rubber seed cake	18.6	66.0	25-30	HCN(9mg/100g)
Sal seed cake	0.1	57.8	10	Tannic acid(8-10%)
Spent brewer's grain	-	-	50	Nil
Sugarcane bagasse	-	-	Low intake	Lignin(8-10%)
Sunflower straw	-	-	50	Tannins(1.5%)
Sunflower heads	-	-	50	Nil
Tamarind seed	11.3	63.9	25	Nil
Tapioca starch waste	1.8	64.0	25	-

4. Marine wastes, by-products and aquatic plants:

Various by-products are available from fish, prawn, frog, shrimp industry. Mainly prawn shell and head wastes, lobster wastes, fish wastes, frog wastes, shark liver residues, squilla etc. Some aquatic plants are Myriophyllum, Ceratophyllum, Pantaogeton, Nymphaea, Hydrilla, Salvinia, Ipomoea quatica etc. These are very succulent and contain 92-94% moisture. The algae rich in CP (30-70% on DMB), EE (6-8%) and low in CF (5-8%). The digestibility of algae protein is 72% in swine, in sheep 54%. The water hyacinth provides 2.84, 24.95 and 44.69% DCP, SE and TDN respectively on DMB to cattle.

5. Fruit and vegetable wastes

Fruit and vegetable processing, packing, distribution and consumption generate a huge quantity of fruit and vegetable wastes, for example, approximately 1.81, 6.53, 32.0 and 15.0 million tonnes of fruit and vegetable wastes (FVW) are generated in India.

Fresh banana foliage can be fed as such or after ensiling with broiler litter (40:60)or with wheat straw (75:25) to levels of up to 15 percent in the rations of lactating animals without altering milk production. Banana peels can be incorporated at levels of 15 to 30 percent in the diet without affecting palatability and performance of lactating cows. Dried ripe banana peels can be fed to growing pigs at levels up to 20 percent and to rabbits up to 30 percent of the diet without having any adverse effect on the performance. Dried citrus pulp is used as a cereal substitute in concentrate mixture due to its high net energy, NE (1.66−1.76 Mcal/kg DM) value for lactating dairy cows. It can replace 20 percent concentrate in the diets of dairy cattle and up

to 30 percent in lactating ewes without affecting palatability, nutrient utilization, milk yield or its composition. Citrus pulp ensiled with wheat or rice straw in a ratio of 70:30 produces excellent silage. Mango seed kernels can be incorporated in the concentrate mixture up to 50 percent. Tannins and cyanide in mango seed kernels can be removed by soaking or boiling in water and then the kernels can be incorporated at 5−10 percent in the diet of broilers. Mango peels can be fed fresh, dried or ensiled with wheat or rice straw.Due to their high sugar content (13.2 percent) they are highly palatable. Pineapple juice waste can replace the roughage portion in the diets of ruminants completely and cereals partly. Ensiled pineapple waste with straw can replace up to 50 percent of roughage in the total mixed ration of dairy cattle. Fresh baby corn husk, a waste after removing cob for human consumption can be fed fresh, ensiled after wilting or after mixing with cereal straw. These are more acceptable and palatable as compared with conventional maize fodder.Fresh cauliflower and cabbage leaves with stems are a rich source of proteins, soluble sugars, both macro- and micro- elements and have good digestibility and dry matter intake. These can be fed either as such, after drying or ensiling with cereal straws, without affecting the palatability, nutrient utilization, health or performance of livestock. Fresh carrot contains 88 percent water, 10 percent crude protein (CP), up to 60 percent sugars, mostly sucrose and high levels of vitamin C and β-carotene.From 4 to 8 percent of dried carrot meal in the diet of laying hens significantly improved yolk colour and did not affect egg production. Cull potatoes, a rich source of starch (60−70 percent), can be fed up to 15−20 kg/day in the raw form,without any adverse effect on health of lactating dairy cows. Potato tubers can also be chopped with forage and ensiled. Cooked potatoes are efficiently used by fattening and breeding sows, and can be fed up to 6 kg a day. Cooked potatoes can be used up to 40 percent in poultry rations. Sun dried tomato pomace (TP) is a good source of lycopene. The dried TP can completely replace concentrate mixture without any adverse effect on nutrient utilization in adult buffaloes; while in lactating animals it can include up to 35 percent of the concentrate mixture without any adverse effect on milk yield. In the diet of rabbits it can be incorporated up to 20−30 percent, while in broiler and layer diets it should be added up to 5 and 10 percent respectively.

Table 4. Chemical composition of some fruit and vegetable wastes

Name of the waste	% Composition (DM basis)				
	OM	**CP**	**EE**	**CF**	**Ash**
Banana leaves	89.84	8.50	2.78	24.30	10.16
Banana peels	85.25	6.45	3.23	10.09	14.75
Mango peels	93.56	7.99	2.64	18.03	8.06
Papaya leaves	93.25	16.05	1.82	21.83	6.75
Orange leaves	96.08	6.89	3.65	31.22	3.92
Cabbage waste	87.60	10.12	2.91	13.82	12.40
Cauliflower waste	89.62	18.12	4.92	14.50	10.38
Brinjal waste	91.74	17.42	3.10	22.55	7.82
Pumpkin waste	94.58	15.12	3.98	14.79	5.42
Bottle gourd waste	92.14	16.05	2.55	15.69	7.59
Raddish	85.70	12.80	2.10	9.98	14.30
Potato skin	90.33	12.75	3.40	9.34	9.67

4. BIOTECHNOLOGICAL APPROACHES IN ANIMAL HUSBANDRY FOR ENHANCING FARMERS' INCOME

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Agriculture is the backbone of the economic system of a country. Farmers are the mainstay of this backbone. By providing the food that we eat, the farmers feed the human society. Livestock farming is an important subsector of agriculture in Indian economy. It is a complementary enterprise to crop cultivation. It contributes to health and nutrition of the households, apart from providing supplementary income in the rural sector. The livestock industry plays an indispensable role in improving the national economy and enhancing people's standard of living. The livestock sector makes a significant contribution to the agricultural economy. It not only provides nutritious food but also provides significant employment in the rural sector, particularly among landless, small and marginal farmers. In India, the livestock sector contributes about one-fourth of the agricultural Gross Domestic Product (GDP) and 4.11% to overall GDP, and employment to about 8.8 % of the population. The livestock resource of India includes 304 million bovines, 74 million sheep, 149 million goats, 9 million pigs and 852 million poultry as per 20th Livestock census. As per 2019-20 records, annual Indian milk production is 198.4 million tonnes, 114.38 billion eggs, 36.74 million kg wool and 8.6 million tonnes meat.

Increasing agricultural productivity with focus on livestock production, protection from diseases, and dairy development is a major requirement in the path to alleviate rural poverty in India. Unfortunately, the farmers are facing tremendous challenges to meet the demanding agricultural production. These challenges include infrastructure to connectivity, growing demands for animal proteins, food spoilage and diseases. Defective animal health is the major cause for low production and improvements in this sector could save farmers nearly Rs.20,000/year in direct costs.

Biotechnology is an applied branch of biology that harnesses living systems or organisms to make socially useful products. Biotechnology tools help in improving animal health and welfare,

thus contributing to enhancement in livestock productivity. Biotechnology utilizes techniques to improve the meat, milk and eggs. It could enhance ability to detect, treat and prevent diseases. The science utilizes techniques to alter the animal genome for the development of pharmaceutical, agricultural or industrial products. Particularly, the use of advanced genetic engineering tools holds great promise for improvement in animal health, which in turn can help improve the farmers' income and national economy. Animal biotechnology has the potential to enhance the farmers' welfare by improving the livestock production capacity and by systematic management. Apart from helping to alleviate poverty and hunger, biotechnology holds great promise for potential transformation in the veterinary field of treatment and significant improvement in the diagnosis of livestock diseases.

A major application of animal biotechnology is to alter the animal genome for the development of pharmaceutical, agricultural or industrial products. By looking at the gene interactions in a living animal, one could understand how genetic makeup influences the animal's growth and development. By being strategic with animal selection and breeding decisions, livestock genomics allows farmers to optimize the productivity and profitability of livestock rearing. By introducing desirable traits through new genes into farm livestock, food quality may be improved.

With the growing population of the world and the high requirement for the supply of livestock products, there is demand for sophisticated techniques for genetic improvement of the livestock. Livestock agriculture has to provide more livestock products with improved efficiency. In this regard, the techniques like artificial insemination, embryo transfer, animal cloning, marker-assisted selection that assist the animal breeding programs would bring about superior genetic improvement of productivity and developing desired healthy livestock allowing to produce healthier offspring and thus improve animal production. In addition, cloning and transgenesis could help develop bio-factories. Further, the development of genetically modified animals would enhance production by incorporating favourable traits.

The new generation vaccines that are being developed using biotechnology are graced with several advantages like stability, non-infectious nature, homogeneity of antigen production and cost-effectiveness in the manufacture. Biotechnology-derived veterinary vaccines could be used to control infectious diseases, to increase productivity by modulating hormones or immune

system functions, as well as for immune castration, etc. Timely control of a disease requires accurate diagnosis. Also, the molecular diagnostic tools have led to control of several diseases, specifically through the development of monoclonal antibodies (mAbs), nucleotide sequencing and techniques such as polymerase chain reaction. The recombinant DNA technology helps in the generation of specific reagents which are useful in disease diagnosis, vaccine sero-monitoring as well as in differentiating vaccinated and infected animals. Improved animal health conditions from vaccines and diagnostic tests would result in safer foods for human consumers. The modern genetic engineering tools like the CRISPR/Cas9 are very useful in the production of transgenic animals, creation of animal models for disease study, specific cell line production and genetic diseases treatment.

The biosensor technology, which is yet to be exploited in India, has the potential to revolutionize the livestock management. Biosensors together with artificial intelligence are being developed to monitor real-time milk quality, health and pregnancy hormones. Sensor and data technologies could bring about huge improvements to make tracking and managing livestock much easier and data-driven to improve the productivity and welfare of livestock by detecting sick animals and intelligently suggesting ways to improve the health. The advanced techniques could bring about huge benefits in making better, more efficient, and timely decisions that will enhance the productivity of livestock. The growing concept of Precision Livestock Farming (PLF) utilizes biosensor engineering principles to automate livestock agriculture, allowing farmers to monitor large populations of animals for health and welfare, detect issues with individual animals in a timely manner. These include monitoring cattle behavior, detecting vocalizations such as screams in pigs, monitoring coughs to identify respiratory illness, and identifying bovine pregnancy through changes in body temperature. PLF technologies can also help farmers monitor infectious diseases. The use of PLF technologies will ultimately improve animal health and welfare, thus reducing food safety issues.

Further, the application of biotechnology for the development of improvised feeds with increased digestibility of nutrients, silage inoculants, supplementation of amino acids, mycotoxins diagnosis, removal of toxins and anti-nutritional factors by the enzymatic treatment, inclusion of probiotics, prebiotics, hormones, disease-specific antibodies, to promote gut growth and health, could promote enhanced livestock productivity.

However, major limitation in exploiting biotechnology is the requirement of huge initial investments, which is difficult for producers to meet. Social concerns also often hinder the path of technology adoption. There are many ethical concerns raised all over the world over last decades that have suppressed the implication of biotechnology and genetically modified animals in real farm use.

In conclusion, the growing population of the world and exponential increase of the demand for the supply of livestock products definitely need advanced techniques to boost production. Until now, genetic engineering and biotechnology, have immensely helped our understanding of the nature of genetic information and its potentials. This area of research needs to be continued more vigorously to allow really sustainable applications in future. The potential role of biotechnology in improving livestock and livestock productivity needs to be harnessed for the production of vaccines and other veterinary products. Also, it will be possible for the selection of animals best suited to a specific production environment. With the development of trust and by overcoming the fear concerning the application of biotechnology, this science would bring about solving global hunger and meet future demands. In addition, it is crucial to have an effective regulatory framework for the safe use of these technologies from the biosafety perspective.

5. REPRODUCTIVE TECHNOLOGIES FOR AUGMENTATION OF PRODUCTION FROM LIVESTOCK

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Livestock sector is one of the growing industries which contribute major income to the dairy farmers across the country. Productivity is the key to growth and reproduction is backbone of animal production. Failure of reproduction can leads to great economic loss in livestock industry. The majority of this loss occurs because cows do not become pregnant during a defined breeding season, infertility due to low conception rate and high embryonic mortality rate remains a major problem. Several reproductive technologies have been employed to achieve this goal. Assisted reproductive technologies like Estrus Synchronization , artificial insemination, Multiple Ovulation and Embryo Transfer (MOET), in vitro fertilization, embryo transfer, cryopreservation, cloning, transgenesis, sexing of semen and embryos, stem cell technology, have been introduced to overcome reproductive problems. These technologies are used to increases the offspring from selected females and to reduce the generation intervals in farm animal. These technologies have also been used to conserve the indigenous breeds and also proved to be powerful tools in overcoming the spread of vertically transmitted diseases.

Estrus Synchronization

Estrus synchronization is an alternative strategy to bypass the critical problem of estrus detection. Estrus synchronization is the process of bringing female animals to the heat state of those having preovulatory follicular activity using hormonal interventions that increases the probability of estrous detection and helps for timely insemination to increase conception rate.

Role of Estrus synchronization:

1. To eliminate the need of labour for estrus detection in a large herd.
2. It is a prerequisite for application of embryo transfer technology.
3. Culminates in short intensive period of AI (timed AI).
4. Creates a more uniformly aged calf crop.
5. Increase new born animals, animal fertility, and milk production

Fig. 1. Prostaglandin protocols:

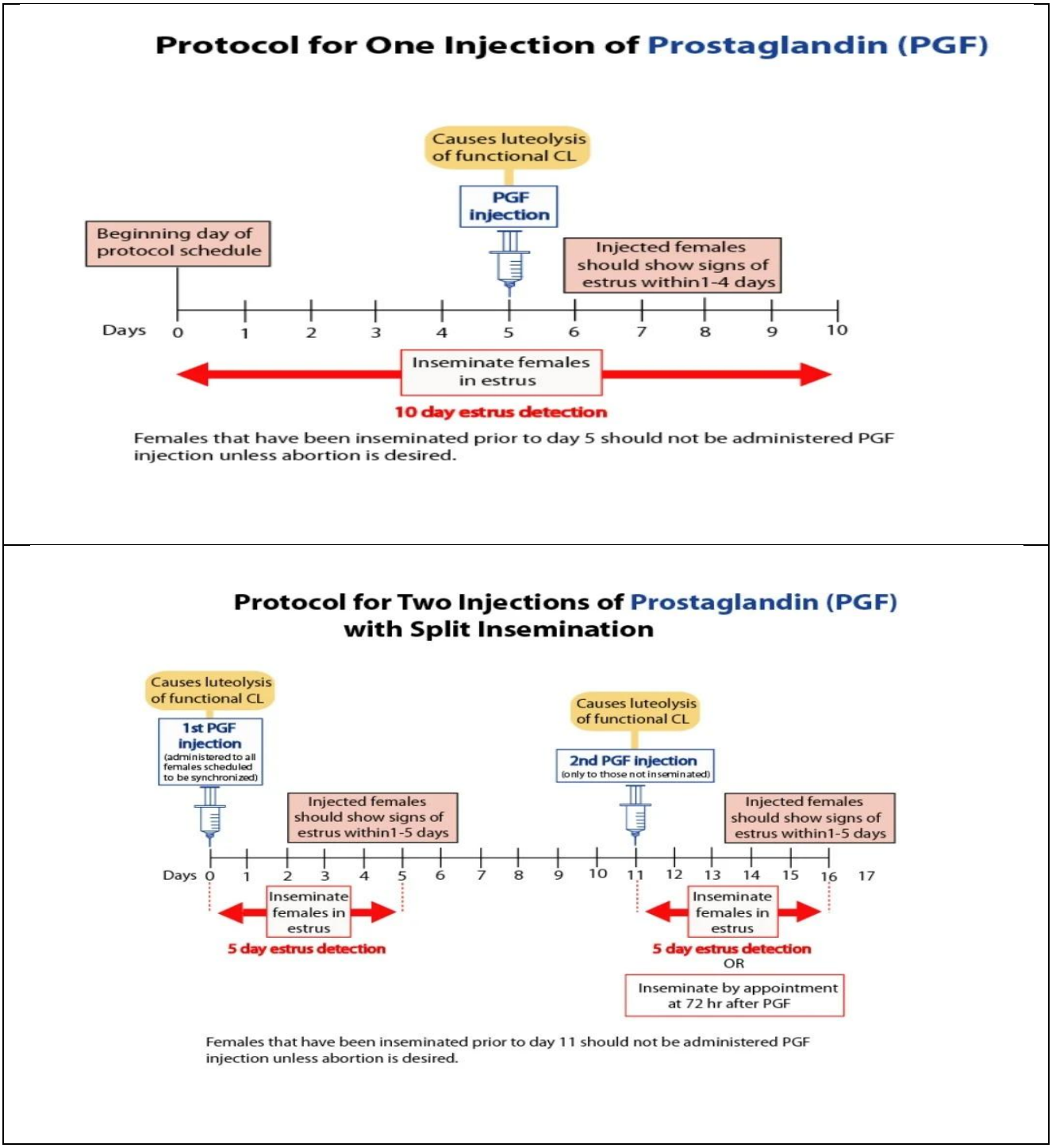


Fig. 2. Synchronization with CIDR protocol

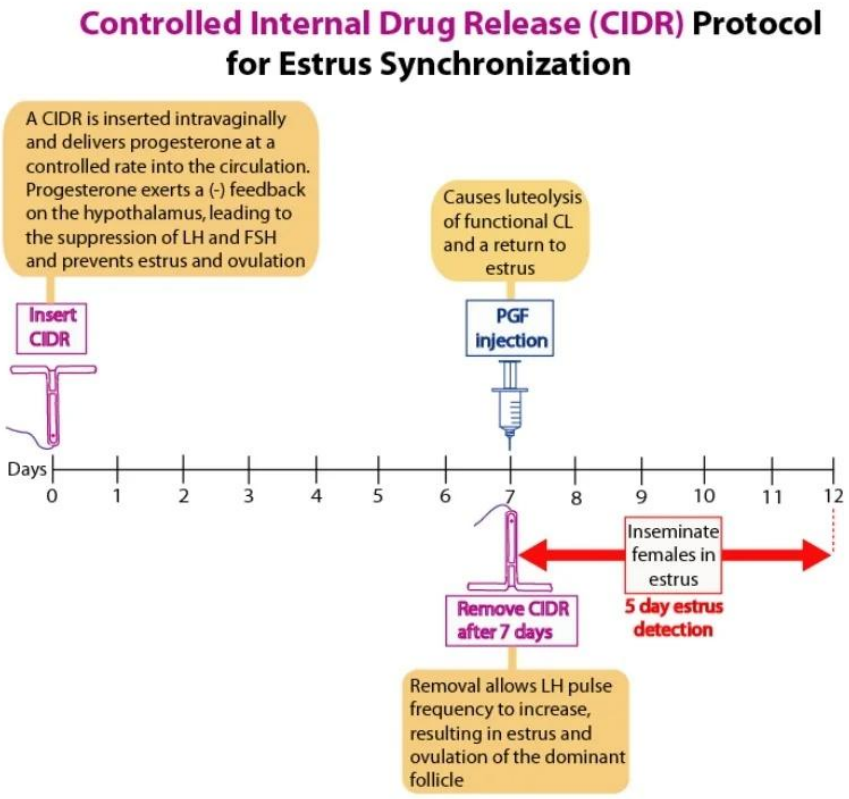
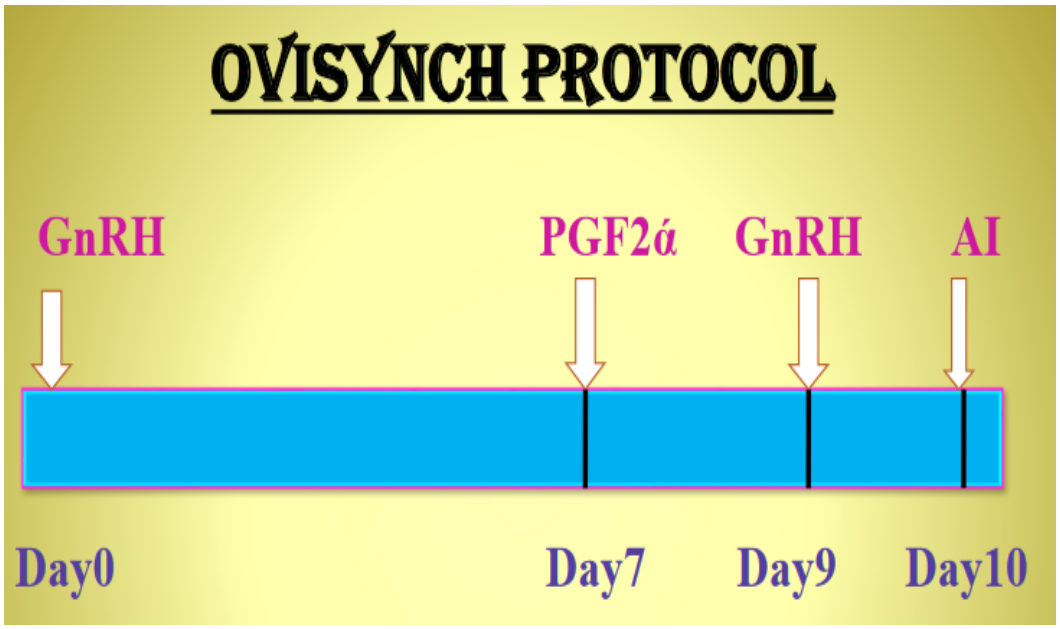
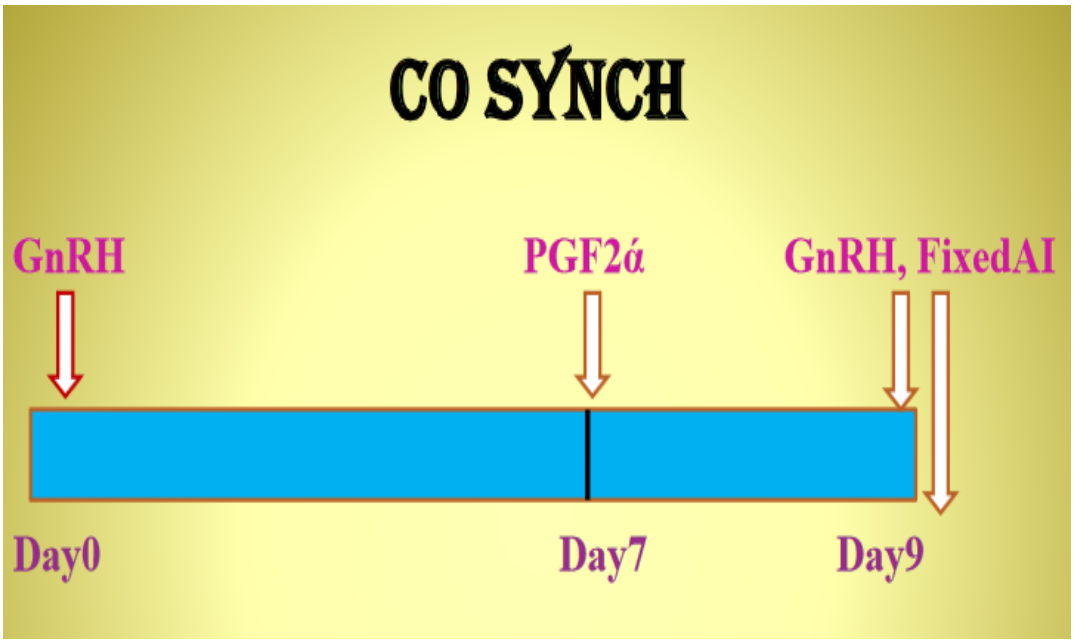
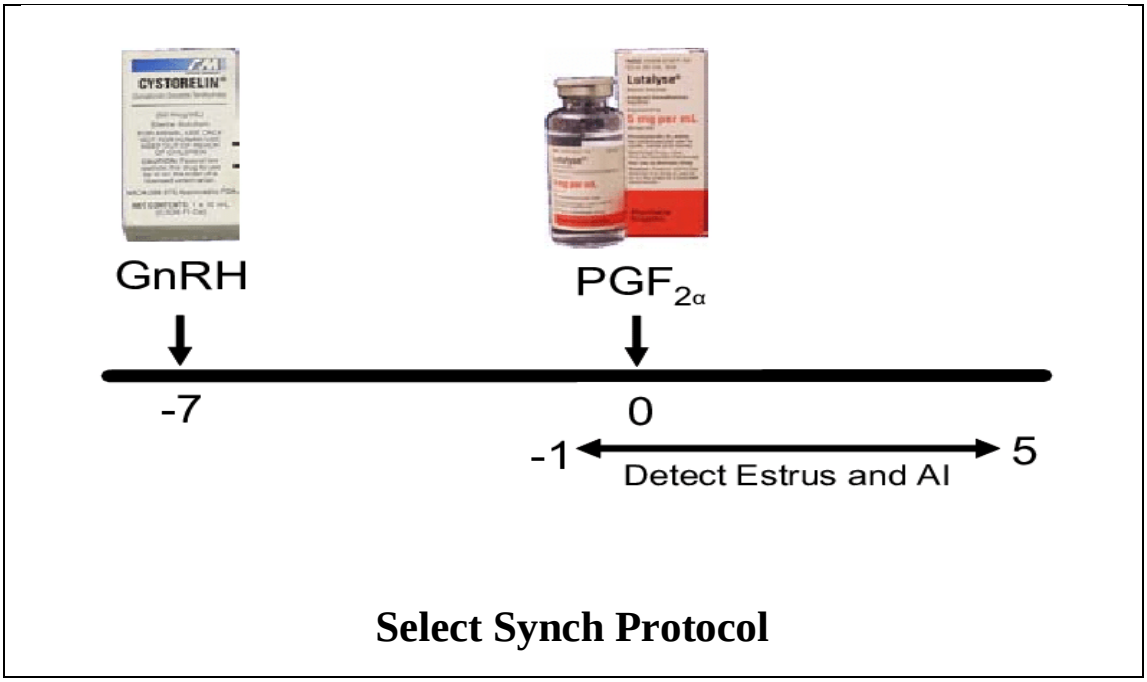


Fig. 3. GnRH synchronization protocol







Select Synch Protocol

Artificial insemination (AI)

Artificial insemination is the first generation ART, which has been in use for more than 200 years. This is a techniques where semen is deposit in female‘s vagina by artificial means. As a modern technology, AI with fresh or frozen semen has been the most successful and efficient reproductive technology in animal production for the last six decades. The use of AI had a major impact on genetic improvement programs in developed countries, associated with 1.0 to 1.5%

annual rates of genetic gains in dairy cattle. AI technology maximizes the use of outstanding males, dissemination of superior genetic germplasm, improve the rate and efficiency of genetic selection, introduction of new germplasm by import of semen rather than live animals and thus, reducing the international transport costs. Use of frozen semen even after the donor is dead and it reduces the risk of spreading sexually transmitted diseases. This will also help in improving bio security and limit the risk for transmission of diseases from farm to farm if semen is processed according to set health standards. At present more than 100 million cattle, 40 million pigs, 3.3 million sheep and 0.5 million goats are artificially inseminated worldwide every year. As per the impact analysis report submitted by NABARD, overall conception rate has increased from 20 % to 35 %. The conception rate in AI programme in developing countries is very low because lack of proper management and technical skill of AI provider and therefore the desired effect in terms of animal improvement has not been achieved so far.

Multiple Ovulation and Embryo Transfer (MOET)/ Super ovulation:

A cow normally produces only one egg per oestrus cycle and the gestation period is 40 weeks. On an average, a cow produces only 2-3 calves in her lifetime. Thus, without intervention, the rate at which a particular desirable cow can be used to improve the genetic status of a herd is slow. MOET programmes could led to increased selection intensity and reduced generation intervals, resulting in improving genetic gains. Multiple ovulation and embryo transfer (MOET) leads to the production of multiple progeny from genetically superior females. However, ET and AI can be very useful, provided that good production practices (husbandry, nutrition, and management) are in place. One of the limiting factors associated with MOET technology is the variability and lack of predictability in follicular development response and embryo production following a superovulatory treatment. However, MOET programs are expensive, mostly due to the cost of labour and hormone treatments. For these reasons, MOET will probably continue to be more intensively used by elite cattle producers. Use of transvaginal, ultrasound-guided follicular puncture for oocyte retrieval (commonly named ovum-pick-up, OPU) may make MOET more effective since it waives super ovulation and AI treatments, by the collection of oocytes (up to 1 thousand oocytes can be collected from a heifer/cow per year) and following in vitro embryo production up to 300 in vitro produced, embryos can be obtained per year.

Recently, Breeding farm in Himachal Pradesh the birth of male calves named ―Gaurav (2010) and ―Saurabh (2011) and two female calves ―Ganga and ―Jamuna in 2012 at livestock farm, Kotlabarog, H.P. World‘s first ever Mithun calf through embryo transfer technology was born at the National Research Centre (2012) .

Superovulatory protocol of Folltropin-V (purified porcine FSH)

Day of cycle	Treatment	
	Morning	Evening
Day 0	Oestrus	
Day 10	80 mg (2.5ml FSH)	80 mg (2.5ml FSH)
Day 11	60 mg (2.0ml FSH)	60 mg (2.0ml FSH)
Day 12	40mg (1.5ml FSH)	40mg (1.5ml FSH) + $PGF_{2\alpha}$
Day 13	20mg (1.0ml FSH)	20mg (1.0ml FSH)
Day 14		AI
Day 15	3000IU of hCG	AI
Day 21	Flushing	$PGF_{2\alpha}$ + Intra uterine antibiotic

Cryopreservation of Embryos and Gametes:

Frozen semen boosted the dairy industry, for making AI simpler, economical, and successful, short fertile life span of mammalian oocytes hence, storage of unfertilized oocytes would generate a readily available source, which allow the experiments to be carried out at convenient time and could therefore be of practical importance Preservation of oocytes reduce the risk and expense involved in transport of live animals, hazards of disease transmission and also provides insurance against natural disasters. Preservation of oocytes of endangered species safeguards from danger of extinction.

In-vitro Fertilization (IVF):

The first IVF followed by birth of offspring was achieved in the rabbit. Now, unfertilized eggs are fertilized in the laboratory and cultured for a few days until they have developed into early embryos. These are then transplanted in to the recipient cow that has normal oestrous cycles. In vitro embryo production technologies not only help in production of high genetic merit animals but also provide an excellent source of embryos for embryo sexing, cloning, nuclear transfer and transgenesis. Through IVF we can analyse developmental potential of embryo, including the pattern of cytogenetic disorders, epigenetic modifications, and gene expression during the development. In spite of continuous efforts to improve bovine in vitro embryo production (IVP), its efficiency is still low, since only 30% to 40% blastocyst development has been obtained from oocytes after in vitro maturation, fertilization and embryo culture. In vitro produced embryos were used to facilitate breeding of transgenic bulls. Frequency of transgene transmission varied from 3% to 54% between bulls. However, the practical use of IVEP is limited by high production costs and the low overall efficiency under field conditions.

Sexing of semen and embryos

Predetermination of the sex of offspring would provide a greater number of males or females, which will help in selection of individuals with top genetic makeup for improvement in next generation. The sexual differentiation of embryo is determined by the presence or absence of elements normally located on the Y chromosome. Some of the techniques for sexing are i) chromosomal analysis of embryos ii) immunological detection of embryonic H- Y antigen iii) use of Y-specific probes iv) Fluorescence in situ hybridization (iv) rapid sexing method for pre-implantation embryos of bovine using Loop-Mediated Isothermal Amplification (LAMP) reaction. Another way is the sorting of semen, one sperm at a time, into males and females, using staining procedure and detecting by laser beam with the help of standard flow cytometry equipment. The bovine Y- chromosome specific sequences are conserved amongst buffalo, Indian zebu and Taurus cattle. Thus, the use of bovine Y chromosome specific primers, demonstrate the sex of buffalo or Indian zebu cattle embryos. Embryos can be sexed with the help of a DNA probe in early embryonic stage. Recently advances in semen sexing, using fluorescence activated cell sorter (FACS) offspring of pre-determined sex have been successfully produced using fresh and frozen-thawed spermatozoa in several mammalian species: cattle, goat, pigs sheep. The sex sorting process by flow cytometry is the most efficient method to separate X from Y spermatozoa in a large scale. Advances in semen sex sorting have enabled incorporation of this technology into commercial operations. Despite the significant advances in sex-sorting sperm using flow cytometry in cattle, lower pregnancy per AI (P/AI) and reduced in vivo embryo production is achieved when compared to the rates obtained with non sexsorted sperm. Semen and embryo sexing have not been reported in the field in any of the developing countries, except China. Although the greater variability on the pregnancy outcomes of cattle inseminated of with sex-sorted sperm by literature, most part of the researches with heifers indicates that conception rate after AI upon estrous detection with sexsorted sperm is about 70% to 90% (according to the farms handling) from the conception obtained following the use of conventional semen.

Cloning:

Animal Cloning is the development by which an entire organism is reproduced from a single cell taken from the parent organism and in a genetically alike. This means the cloned animal is an exact photocopy in every way of its parent; it has the same exact DNA. It can be used for the conservation as well as propagation of endangered species. Cloning using somatic cells offers opportunities to select and multiply animals of specific merits. First animal obtained by somatic cloning was a sheep, ―Dolly (Willmut et al., 1997), using a cultured adult somatic cell with an enucleated oocyte. Since then, SCNT was used successfully for cloning cattle, goat, pig, and horse. Microinjection of DNA into the pronuclei of recently fertilized ova is the most common technique used to produce genetically engineered livestock. Introducing a new technique - Hand guided Cloning Technique world's first buffalo female calf GARIMA (2009) and a male buffalo calf, - SHRESTH (2010), female calf was born from cloned buffalo GARIMA, NDRI has named the newborn female calf - MAHIMA, male buffalo - SWARN born

from the somatic cell of semen (2013), female buffalo ―PURNIMA (2013),-LALIMA (2014), Male cloned calf named ―RAJAT (2014) have been born at NDRI, Karnal India.

Transgenesis

The term transgenic animal refers to an animal in which there has been a deliberate modification of the genome, in contrast to spontaneous mutation. Initial demonstration was "super mice" in 1980s. These mice were able to produce the human protein tPA to treat blood clots. The use of recombinant DNA techniques is to introduce new characters (i.e. genes) into organisms (including humans) that were not present previously. Transgenic farm animals can be used both in breeding and biomedicine. Transgenic animals show individuals are improved in quantitative, qualitative traits and they are resistance to disease. Some examples live sheep with integrated keratin-IGF-I gene and higher production of wool, sheep and goat with antitrombin III and antitripsin in milk. An important achievement was production of transgenic cows resistant to mastitis. Transgenic domestic pigs are used in studies on xenotransplants. Scientists are going on for production of environment-friendly transgenic individuals which are used to understand various physiological processes in farm animals and humans.

Stem cell technology

Stem cells are characterized by their self renewal capacity through mitotic cell division for indefinite proliferation in vitro in an undifferentiated, pluripotent state. Embryonic stem cells possess the in vitro and in vivo capacity to differentiate into any specialized cell type, from in vitro formation of embryoid bodies to in vivo differentiation into somatic and germ cell lineage. Stem cells are having various applications like, model for developmental biology, gene therapy, organ transplantation, drug development, chimera production and in the field of regenerative medicines. Its application in large animal models in which the embryo stem cell technology can be tested for tissue-specific differentiation and cell therapy of various tissues and organs. The successful transplant of testicular tissue containing spermatogonial stem cells (SSCs) used in goat and pig is readily adapted in cattle. By transplanting SSCs from elite bulls into lesser bulls followed by natural service, elite genetics could be disseminated more widely. This system could create an alternative to artificial insemination for the use in elite sires in the cattle industry in areas where AI is not practicable.

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6. APPLICATION OF MOBILE APPS AS TECHNOLOGY TRANSFER TOOLS IN ANIMAL HUSBANDRY

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The number one benefit of information technology is that it empowers people to do what they want to do. It lets people be creative. It lets people be productive. It lets people learn things they didn't think they could learn before, and so in a sense it is all about potential.

-Steve Ballmer

Transfer of technology is the process by which science and technology are diffused throughout human activity. Mobile applications are digital tools which can be effectively utilized to disseminate animal husbandry related information to a large number of farmers spread across the globe within a short period of time. These applications can be used to enhance farmer's income and productivity through providing correct information, better input and farm management, easy marketing and linkage with government agencies for policy support to farmer etc.

However, there are challenges like low smart phone penetration rate in rural India, variable internet connectivity, low digital literacy, limited availability of animal husbandry related information in local languages for the farmers etc.

But present scenario is that, after launching of Unified Payments Interface (UPI) by government of India, people have started using the mobile for online payments, now we can see

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the public using UPI based online payment apps in their mobile phones and demonetization has also played an important role in the use of the online payment apps. Despite the fact that the pandemic (Covid-19) has bad impact in society it has hastened the technology dissemination by at least 5 years than the otherwise normal speed. Now we can see almost every small and big institution, schools, colleges are using the online platform for the study and day to day practices as well. In our country work from home culture is also taking pace. During Covid-19 pandemic the importance of digital tools was judiciously observed to fulfill the requirement of daily to emergency use items. After seeing all these we can say that now a days low smart phone penetration rate in rural India is not such a big problem compare to the last few years.

Modern digital tools *viz.* blogs, websites, social media, mobile apps, internet etc. can play a major role in faster technology dissemination. Farmers upgraded themselves with this real time and targeted information through digital tools for getting maximum profit and minimizing losses. The proliferations of online marketing platforms provide farmers to enter full market access without intervention of intermediaries.

Now, farmers can easily access these portals through their smart phones. Through internet they can get the information pertaining to current market prices and many animal husbandry related facts that can be used for securing profits/benefit.

A range of new digital tools e.g., Mobile apps have been developed for the benefit of the farmers for improving animal husbandry related information, transfer efficiency and significantly impact animal husbandry related business. Digital tools can play a key role for understanding and improving animal husbandry related value chains. Digital tools provide easy access and adoption opportunities to introduce new technology among farming communities through audio-visual services. Using technology across the value chain makes it into significant improvements in food security for growing populations.

ADVANTAGES OF USING ANIMAL HUSBANDRY RELATED MOBILE APPS

Affordability, wide ownership, voice communication and instant and convenient service delivery are major benefits of mobile phones. Due to these, there is explosion in the use of mobile apps across the world, facilitated by the evolution of mobile networks and by the increasing functions and falling price of mobile handsets (World Bank, 2012).

- Several animal husbandry related mobile apps have been developed by public and private sector organizations which are benefitting farmers.
- Helping animal husbandry farmers through text and video messaging services.
- Convenience and door step service delivery service across the country.
- Keeps the farmer updated with the trades and fund transfer including instant messaging.
- Farmers can increase their knowledge regarding breeds of the animal which is suitable for their region and by using these knowledge farmers can increase their income and productivity of their animals as well.
- There are mobile applications providing information regarding livestock production, management and also helpful for the prevention of the diseases.
- Farmers can educate themselves regarding value addition for the food products of animal origin.
- Online monitoring and management of livestock/poultry/ fisheries etc. is possible through mobile applications.
- It provides with the facility for feedback from farmers and other stakeholders.
- Information of different machineries and equipments related to animal husbandry is easily accessible.
- Mobile apps can be utilized for delivering services offered by government like input supply and direct account transfer of various subsidies.
- Category wise easy retrieval and referring of vast information in real time.
- It helps in better marketing and efficient storage of animal husbandry related products for use in far-off markets.

CHALLENGES OF USING MOBILE APPLICATIONS IN INDIA

- Most of the times, farmers are not adequately equipped with required knowledge and skill to use mobile apps.
- Low digital literacy to operate and to gain advantages from the available applications.
- Diversity in language across the country makes it further difficult to make mobile apps in all local languages.
- Poor translation may further hamper the quality of content and can reduce its acceptability among farmers.

- ❖ Although quality smart phones are affordable now but it also needs good internet connection and speed to run the mobile apps smoothly.
- ❖ Rural areas still lacks good coverage and internet speed.
- ❖ Though majority of mobile apps are free but few apps are charging fees and due to poor paying capacity the farmers may not afford paid services.
- ❖ Though there is increase in the number of smart phone users, lower adoption and use of mobile apps by farmer in some areas of the country is a big challenge and efforts are needed to enhance digital literacy.
- ❖ Sometimes low accuracy of data in apps, uneven digital access and less-availability of content as per local requirement are important challenges in easy adaptation of mobile apps.
- ❖ Limited numbers of applications are available in animal husbandry as compared to other sectors like health and sports.

In order to overcome all these limitations, we must rely on increasing digital literacy campaigns so that the available mobile applications can be used as the means of transforming natural resources into productive resources through technological interventions.We can also utilize these positive changes in animal husbandry by using mobile apps which are helpful for the farmers to increase their income by manifold.

Name of few mobile apps of animal husbandry which are beneficial for the farmers:-

1. Dairy App by MAFSU, Nagpur (http://www.mafsu.in/Download.aspx).
2. Goat App by MAFSU, Nagpur (http://www.mafsu.in/Download.aspx).
3. Poultry App by MAFSU, Nagpur. (http://www.mafsu.in/Download.aspx).
4. Pashu Poshan by NDDB. (https://play.google.com/store/apps/details?id=coop.nddb.pashu_poshan)
5. Precision Dairy Farming (for cattle and buffalo) by GADVASU, Ludhiana, Punjab. (https://play.google.com/store/apps/details?id=in.gadvasu.livestockhusbandry)
6. WMG App (Waste management guide app) by IVRI, U.P. (https://play.google.com/store/apps/details?id=com.icar.ivri.iasri.wmapp)
7. Dairy Manager App by IVRI, U.P. (https://play.google.com/store/apps/details?id=com.ivri.iasri.dmapp)

Mobile apps have the potential to increase competence, output, competitiveness and escalation production and productivity in animal husbandry, social sectors and in a variety of other business related with it. All these can be possible by providing the access to information and through exchange of information. Mobile phone plays very important role in dissemination of animal husbandry and related sector's information. We can easily converse with large number of farmers and also disseminate the necessary information at one time in an organized way so that farmers can derive knowledge leading to meaningful actions.

7. ENTREPRENEURSHIP IN ANIMAL HUSBANDRY – A TOOL FOR DOUBLING FARMERS' INCOME

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Doubling of farmers' income is indeed a very big task. Majority of the farmers we are talking about are marginal, small and landless labourers, they are less endowed, unorganised, scattered, have poor access to information, production technologies, etc. On the positive side, there is much enthusiasm among the young to involve in animal husbandry (AH), especially, post COVID situation. In this context, a holistic approach is needed to achieve this task. All the stakeholders involved in achieving this goal need to act coherently for which an entrepreneurial approach is very much needed. Let us try to understand the whole gamut of entrepreneurship under two broad headings, one under development perspective, two under the farmers' perspective.

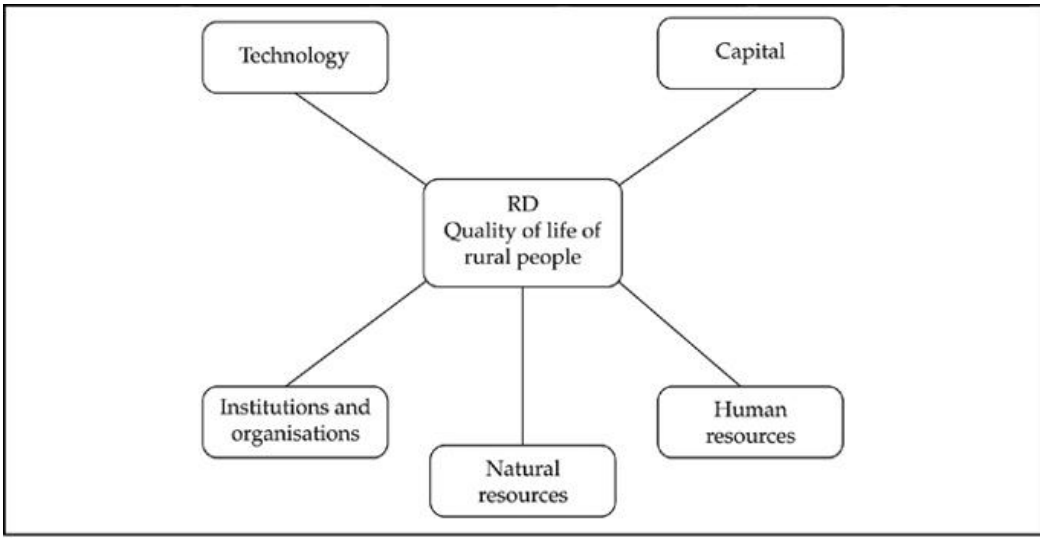
Understanding entrepreneurship under Development perspective:

It is better that we consider the popular development paradigm of rural development (RD) given by Katar Singh. He discusses the issue of RD under five major dimensions, viz, natural resources, Institutions and organizations, technology, capital and human resources. The issue of entrepreneurship in animal husbandry can be addressed only if these five dimensions of RD are addressed in total with good co-ordination of all the stakeholders. Let us discuss these issues in brief.

Natural Resources: The basic elements with which the farmer can meddle about are natural resources namely, land, water, plant and animal genetic material. For the livestock farmer, it is the domestic animals, feed and fodder, water, conservation and preservation of the same, various means of increasing and maintaining optimal productivity of the same. There are issues with the availability of good breeding stock- dairy, small ruminants, pigs and poultry. The problem of male off springs of the crossbred cows is persistent. Likewise, feed and fodder shortage is pervasive throughout the nation.

Institutions and organizations: These are the entities in the societies which co-ordinate the development processes. In relation to AH, Dept. of Animal Husbandry & Veterinary Services, Milk Co-operatives, certain NGOs, private entities, etc, are the prominent players. Though health care services of livestock are taken care by the Govt. departments, constraints of under staff and poor funding come in way of effective reach of their services. Likewise, co-operatives are taking care of marketing of milk. However, their market share is also limited. Political interference in

the functioning is also there. Small ruminants, backyard poultry, piggery is neglected. Broiler industry is in the folds of private sector.



Source: Katar Singh, Rural Development, Sage Publication, New Delhi

Technology: Appropriate technologies suiting to the various farmer categories of farmers are the need of the hour. Mechanization is the order of the day. The research institutions and Agriculture and Veterinary universities are falling short to cater these needs. Effective mechanisms to transfer the generated package of practices and technologies are inadequate. Poor coordination among the technology generation and technology transfer institutions is predominant.

Capital: Capital in one of the important factor for entrepreneurship development. The needy farmers face problem in availing timely capital. Loans and subsidies channelized suitably to reach the right beneficiary are required.

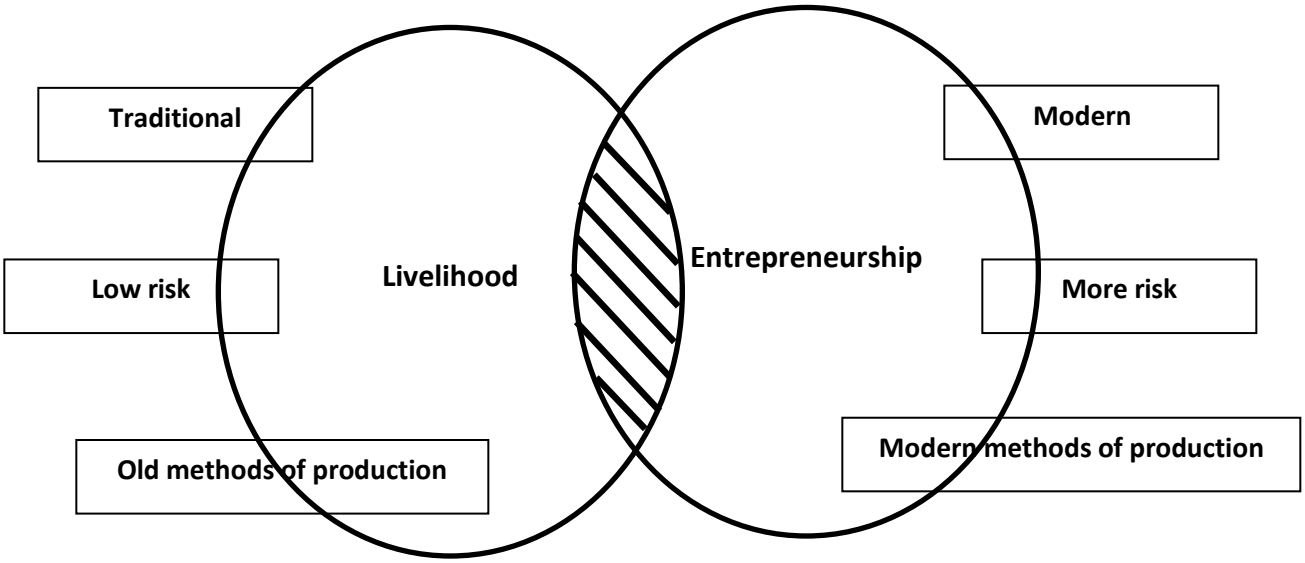
Human resources: Human Resource Development is one of the prominent factors in RD. It is true with the agriculture production process. It is the entrepreneur who co-ordinates all the other factors of production namely, land labour and capital. In this context it is worth dwelling a little more on the issue. The approach of the farmer to agriculture and livestock becomes important. Whether it is a livelihood approach or an entrepreneurial approach is the question. Many a times it would turn out to be a livelihood approach.

A livelihood is the ability of that individual to obtain the basic necessities in life, which are food, water, shelter and clothing. Therefore all activities involved in finding food, searching for water, shelter, clothing and all necessities required for human survival at individual and household level are referred to as a livelihood. In majority of the farming community, the approach would be to secure the livelihood which is subject to various natural

and manmade shocks, such as drought, floods, price fluctuations, etc. Many tend to play safe in the production process.

However, an entrepreneurial approach demands, carefully understanding of the production process, invest calculatedly, produce what is needed by the people and sell them diligently to make profits. This approach is what is needed to foster entrepreneurship in the farming community. Taking stock of the changing societal needs, the farming community need to be motivated, trained, mobilized and guided to explore and exploit the market potential and make the profits. Here comes the role of various institutions and organisation to foster entrepreneurial qualities among the farmers. A close watch at the figure below depicts that a moderate overlapping of the livelihood and entrepreneurial approach is what yields better income and quality of life. Thus, a careful analysis of the whole gamut of development dimensions in the livestock sector throws opportunities for an entrepreneur to build an enterprise. Wherever, there is social concern, social entrepreneurship can also fill the gap.

Fig. Livelihood Vs Entrepreneurship



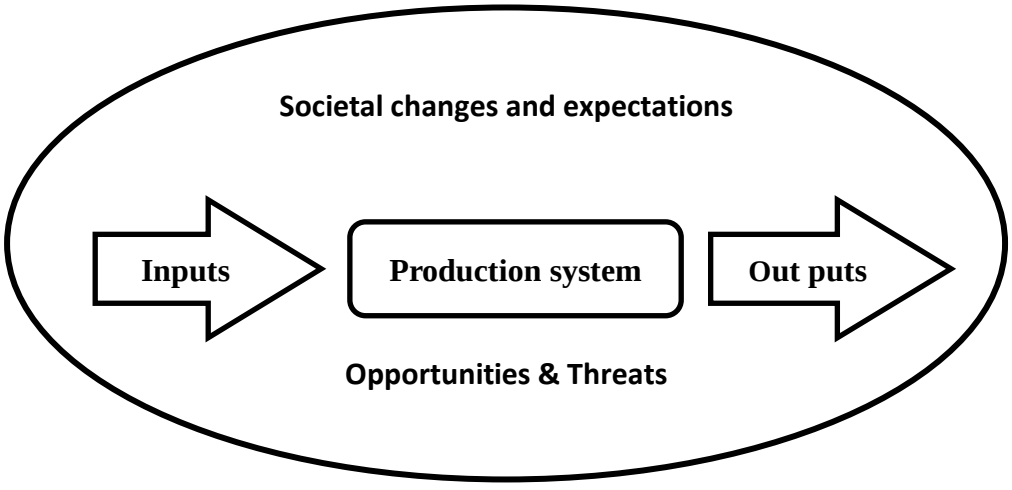
A small attempt is made to make an indicative list of possible entrepreneurial avenues emerging out of the gaps in the five dimension of RD.

Dimension of RD	**Gap**	**Entrepreneurial avenues**
Natural resources	Poor availability of germ plasm Shortage of feed & fodder	Breeding stock farms Hatcheries Production and distribution of sexed semen

		Fodder & feed production Silage Production
Institutions and organizations	Inadequate healthcare Training of farmers & escort services Poor organization of farmers	Private practice Training centres NGOs – promotion of SHGs, FPOs
Technology:	Poor awareness about technologies Inadequate access to technologies	Media development Technology manufacturing, distribution
Capital:	Poor access to finance	Promotion of micro-finance institutions
Human resources:	Lack entrepreneurship	Training & End-to end consultancy services

Understanding entrepreneurship under farmers' perspective:

From a farmers' perspective the whole issue of entrepreneurship avenues can be viewed in a three step paradigm – input –process –output. In each stage of the production process there are avenues for and entrepreneur. Careful examination of the production process, its requirements, its production constraints, the way its outputs are processed and dispensed, societal changes & expectations, all give insights for an entrepreneur to work upon a business idea and build a business. It is said that each there are no dearth of opportunities for an entrepreneur. Every problem a customer faces is an opportunity for an entrepreneur. An indicative list is given below.



Input	Process	Output
Supply of germ plasm Supply of breeding animals Feeds and fodder Silage Fodder seeds Dealership in equipment Dealership in medicine supply Consultancy services Providing AI services Providing shed construction services Providing vaccination services	Various types of farms – dairy, sheep & goat, poultry, piggery, canine breeding	Sale of livestock Sale of meat, eggs, milk, etc. Value addition of livestock products Delivery of livestock products Hotel business with livestock products Leather business Sale of dung Vermicomposting Value addition of dung and urine

A common farmer involved in production process can adopt the following various steps stabilise his production capabilities and increase his profits.

Reduce the cost of production

- By reducing the incidence of disease by adopting preventive health care practices like deworming, vaccination, cleanliness in sheds, etc.
- By decreasing the cost of production – use cheaper and right quantity of inputs, decrease the quantity of feeds and increase quality fodders
- By reducing the cost of transportation – by batch transportation, sales at home, etc.
- By reducing the advertisement charges – by developing customer loyalty, word of mouth publicity, etc.
- By reducing the overhead charges – such as optimal number of animals, labourers, optimal use of space, optimal use of water, etc.

- By reducing the number of intermediaries – by direct sales to customers

Increase the value of the product and thereby profits

- By value addition of the products
- Maintain quality of the products
- Segmentation of the customers
- Exploring the opportunity for exports

The above list is just indicative. The farmers can further sense the changes in society and customize their services. This is a diligent character of an entrepreneur who senses the opportunities and ceases it to his folds. An indicative list of what type of change in the society has yielded different entrepreneurial opportunities as encashed by different enterprise is given below.

Societal change /problem faced	**Opportunity**	**Example of the enterprise**
Broiler famers faced problems in contacting different agencies to produce chicken	Provide integrated services	Suguna, Venkys' & other companies – Most of the broiler production is under integration.
Need for antibiotic and chemical residue free milk	Provide organic milk	Akshayakalpa organic milk and milk products
Difficulty in going to market and purchasing good meat	Door delivery of meat	Fresh cuts, Fipola-the meat super store, Licious
Increased purchasing power of the public	Sell meat and milk products	KFC, DOMINOS, Five Star, various numerous Non-Veg hotels & street food stalls
Urbanization and dwindling of family size	Need for pets	Canine breeding & Pet Clinics
Increased consumption of meat during festivals	Supply of timely quality meat	Batch synchronization by entrepreneurs to get marketable stock

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8. USE OF VETERINARY DIAGNOSTIC LABORATORIES FOR ENHANCING LIVESTOCK PRODUCTION

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Globalization in the agricultural sector increases the potential for animal disease introduction. Increasing trade expands opportunities for transmitting animal diseases across borders. Many countries are largely protected from major outbreaks of animal disease through border inspection regimes and performing testing of Transboundary Animal Diseases (TADs). The potential economic importance of the introduction of a significant animal disease is evident when one considers that approximately one-half of agricultural income derives from the animal product sector. A devastating animal disease outbreak would have serious economic impacts on producers, the marketing chain and gross agricultural income. India suffers a loss of 20,000 crores due to the adverse effect of diseases affecting the livestock . The estimated economic loss due to bovine mastitis is Rs 7,165.5 crores out of which 57.93% (Rs 4151.1 crores) is attributed to subclinical mastitis.

Disease acts as a negative influence on the livestock production system, thus setting off a cascading effect of low production, low income, and subsistent livelihood. The consequences of animal diseases in livestock can be complex and generally go well beyond the immediate effects on affected producers. These diseases have numerous impacts, including productivity losses for the livestock sector (production losses, cost of treatment, market disturbances), loss of income from activities using animal resources (energy, transportation, tourism), prevention or control costs (production costs, public expenditure) and suboptimal use of production potential (animal species, genetics, livestock practices).

Highly contagious livestock diseases such as foot and mouth disease (FMD), hemorrhagic septicemia (HS), mastitis, peste des petits ruminant (PPR) and surra in cloven footed domestic animals cause irreparable economic losses to the farming community. They also occupy the top position among the livestock diseases due to wide host range, plurality of immunological types, short duration of immunity and economic losses and their impact on livestock production and productivity.

The annual farm level economic loss in India due to different disease peste-despetits ruminants (PPR) about US$ 660 million, Haemorrhagic Septicaemia (HS) was estimated at INR 12700 crores and US$ 3.4 billion, annually, due to brucellosis. Disease control/eradication activities require allocation of substantial amount of national resources

Veterinary diagnostic labs (VDLs) are important service agencies providing essential diagnostic testing for a wide variety of domestic animal species as well as wildlife. Laboratory diagnosis is an important part of any surveillance or control programme and provides support for national disease eradication. State laboratories and Veterinary Teaching Hospitals provide testing for surveillance programme and export purposes, in addition to diagnosis of clinical cases. Many national and State laboratories are developing quality assurance programmes to assure the reliability of testing results.

Many countries around the world have national veterinary services to address various needs of animal health protection and food safety. An integral part of this organization is the veterinary diagnostic laboratories like HSADL, Bhopal in India. Surveillance and diagnosis of clinical cases of animal disease are necessary to determine the existence or introduction of a disease and laboratory testing is a crucial part of these surveillance programmes.

Therefore, veterinary diagnostic laboratories are the backbone of disease control programmes administered by the veterinary services of a country.

Sample/specimen collection, their preservation and physical conditions during transit to laboratory bears an important role in successful performance of the laboratory investigations. Some of the common considerations affecting all types of specimens:

- Specimen should not be collected and transported in expired containers.
- Label should contain all pertinent information required on the test request form.
- Quantity of specimen sufficient to perform the test as per requirements (to avoid QNS -quantity not sufficient)
- Use the container/tube indicated in the test requirements for appropriate specimen preservation.
- Tighten specimen container lids to avoid leakage and/or potential contamination of specimens.
- Specimen has to be maintained at the temperature indicated in the test requirement.

1.EXAMINATION OF BLOOD – Complete blood count (CBC)/Blood smear examination- A blood sample is a highly reliable representative sample regarding the health status of the animal and also can indicate both qualitative and quantitative injury to the organ system or the respective organ. By assessing these parameters at the earliest with minimum invasion into the animal's body will help in diagnosing the diseases early and also accurately thereby lowering the expenditure on prolonged treatments and minimize the non productive unhealthy days of the animal.

- **Anticoagulant of choice for virology :**

DISEASE	PRESERVATIVE FOR BLOOD
Blue tongue	OCG, Sodium citrate, Heparin
Rinder Pest	Heparin
Swine fever	EDTA
Malignant Catarrhal Fever	EDTA @ 1mg/ml of blood

2. FAECAL EXAMINATION- Internal parasitism forms one of the important menace in limiting the animal productivity. Internal parasites compete for the nutritional availability in gastro intestinal tract of the host animal itself. This limits the host animal of its nutritional requirement for its maintenance and productivity inspite of adequate or sometimes excess feed intake leading to going down condition. Undetected or delayed treatment may lead to feed loss, unsatisfactory recovery or even mortality. To prevent this economic loss the regular screening of the animals for internal parasites through microscopic examination of the faecal sample forms a

good managemental practice promising the better health status of the herd and optimum production levels .

3. URINE ANALYSIS / EXAMINATION - It is a scientific examination of urine to mainly assess the health of kidneys and urinary system but can also reveal problems in other systems that is hindering the health of animal and its productivity. There are certain bacteria and paratises (*kidney worms*)that can be detected through urine examination and can be addressed accurately minimizing the treatment cost and maximizing the efficacy of treatment and aiding it profitable production levels**..**

4. RUMINAL FLUID EXAMINATION

Chemical examination

• Ph: papers, meters: Normal:5.5 to 7.0, Rich protein; 6 to 6.8, Starch : 5.5 to 6
• Abnormal: Urea poisonoing / R. decomposition: > 8.5; Acidosis : < 4.5 to 5.0

Rumen protozoa

▫ **Ciliates and Flagellates**

1) Ciliates: large in size & more in Number, have cilia on their surface, found more in adults
2) Flagellates:: few in number, Small in size, having flagella. Common in young animals.

Biological examination

• **Protozoa:** one drop of R FLUID ON SLIDE , Place cover slip , examine under low power
• **Density: Interpretation**

++++/++++ 30 Protozoa/LPF
++ 10 – 30 /LPF
+ 1 – 10 /LPF
- nil

Other clinical or postmortem samples that have importance in disease diagnosis and effective treatment and understanding the diseases process to formulate accurate treatment protocols are as follows:

Below are the samples of choice, preservative used for their transit to laboratories and the respective tests to be performed to arrive at a confirmatory diagnosis and initiate the effective treatment ensuring minimal ailing period to the animal and maximizing their productivity.

Table 1. Important livestock diseases and their laboratory material of choice.

DISEASE	MATERIAL OF CHOICE	PRESERVATIVE	TESTS TO BE PERFORMED
Foot and mouth disease (*Picorna viridae*)	Vesicular fluid from un-ruptured or freshly ruptured vesicles	Glycerol phosphate buffer	CFT or ELISA Isolation of virus in tissue culture
Rabies (*Lyssa virus*)	Impression smears from hippocampus Brain tissue	Chilled condition	Seller's stain for demonstration of Negri bodies Intracranial inoculation into rabbit, Indirect FAT, Modified immunoflouroscence & immunoperoxidase tests Habel's mouse inoculation test
Malignant catarrhal fever (*Gamma herpes virus*)			Immunoflourescence and complement fixation tests
Pox viruses (Bovine, sheep, Goat) (*Pox virus*)	Vesicular fluid		Antigen detection by ELISA Differential diagnosis from Contagious pustular dermatitis virus – Western blotting technique
Brucellosis (Bang's disease, Contagious abortion) (*Brucella abortus, B.melitensis, B.suis*)	10-20ml milk from each quarter Vaginal swabs (after abortion) Spleen, lungs, stomach contents from aborted fetuses Blood samples for serum	Transit on ice	RBPT (by coloured antigen) Skin sensitivity test by Brucellin SAT (1:40 above is positve) Brucella milk ring test Cord test, Strau's test
Tuberculosis (*Mycobacterium bovis*)	Pieces of affected organs along with lymph nodes Milk 20ml blood for plasma	10% formal saline	Histopathology Double intra dermal test (DID) Examination of the bacilli Interferon gamma assay
Johne's disease (*Mycobacterium paratuberculosis*)	Bowel washings, rectal pich smears	Heat fixation	Zeil-Neilsons staining DID by Johnin, CFT, Gel diffusion test
Mastitis	Milk	On ice	California mastitis test,

(*E.coli, Staohylococcus aureus, Streptococcus agalactiae, Str. Pyogenes, Klebsiella spp., Pseudomonas*)		Bronopol	bacteriology of milk Bulk tank /individual animal Somatic cell count (by flow cytometry)
Bovine ketosis	Milk, urine, blood	-	Cow-side tests (to estimate levels of ketone bodies), spectrophotometry
Ruminal acidosis/alkalosis	Rumen liquor		pH estimation, microscoic examination of ruminal protozoal motility
Protozoal diseases (Theileriosis, Babesiosis, Trypanosomiosis)	Peripheral blood smear/serum Urine analyis (Babesiosis)	Ice	Giemsa or Leishman's staining PCR
Helminth infections	Faecal sample Serum sample	Ice	Microscopic examination of faecal sample PCR
Anthrax (cattle, sheep, goat) (*Bacillus anthracis*)	Peripheral bood smear from ear vein Skin and hides		Methylene blue staining/Leishman's staining to demonstrate Anthrax bacilli Ascoli's precipitation test
Peste Des Petits Ruminants (PPR) *(Morbilli virus)*	Blood samples (10ml each) / mucosal lesions in EDTA or heparin Tissue fragments and fluid from prescapular lymph node Epithelium from necrotic lesions/ fluid from lesions/ocular secretions 20ml 0f blood for serology	EDTA/heparin Sterile container 1ml of physiological saline	Agar gel diffusion test Immunoflouroscene test, counter immuno-electrophoresis ELISA
Blue tongue (BT) (*Orbi virus)*	Duplicated blood samples (for serum and whole blood) Precolostrum serum from congenitally		PCR

	infected new born From dead sheep, whole heart blood, spleen, heart, liver Paired sera samples	Chilled and transported on ice (4 degrees centigrade)	Inoculation into BHK-21 cell line or lamb kidney cells / 10-11 days embryonated chicken eggs Competitive ELISA, AGID
Maedi-Visna (*Lenti virus)*	20ml blood for serum Lungs and mediastinal lymph nodes (maedi) and brain (visna)	Dry ice NBF	AGID test and Indirect ELISA Histopathology
Jaagsiekte **(*Beta retro virus*)**			Intratracheal inoculation of fluids from lungs of affected sheep into day old lamb
Hog cholera **(***Pesti virus***)**	Specimen from aborted foetuses, stillborn pigs and runted members of litter 20ml blood samples Tissues – tonsil, pharyngeal and mesenteric lymph node, kidney, spleen, brain	EDTA or heparin with antibiotics (penicillin 200units and streptomycin 200micro gms/ml	Haematology, ELISA FAT or IFT
Swine influenza **(***Type A Influenza virus***)**	Nasal mucus on cotton wool swab Pharyngeal mucus from young pigs Lung pieces during autopsy 20ml blood for serum	2ml brain-heart infusion broth containing antibiotics On ice On ice On ice	ELISA Direct detection of virus Haemagglutination inhibition test /group specific ELISA/Neuaminidase inhibition tests
Transmissible gastroenteritis **(***Corona virus***)**	Tied off loops of affected ileum 20ml of blood for serum	(in sterile container) On ice	IFT PCR, HA and HI tests, ELISA

Veterinary Diagnostic Laboratories, this way help in increasing farmer's income by lessening the treatment cost, lowering the unproductive unhealthy days of animal and increasing the productive efficacy of the animal.

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9. CURRENT TRENDS LIKE MARKET LED LIVESTOCK PRODUCTION AND PRECISION FARMING IN ANIMAL HUSBANDRY

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Animal Husbandry is an age old occupation of our farmers. Initially, it was carried out as subsistence to fulfil food and other demands of the farm households. Gradually, it took commercial form. Today, Animal Husbandry has assumed the role of an industry. It is undertaken as a means of livelihood, business aswell as an enterprise. Many opportunities are opened up on global arena making animal husbandry as a lucrative venture. Many educated youth are also now a days entering this area. Today's market (including that for livestock and livestock products) is consumer dominated market. The trends of urban markets, globalization, liberalisation, changing consumption patterns, land and water constraints, climate change, need for alternative sources of energy including bio-fuels, and emerging diseases are driving development in agriculture. Consumer demands, preferences have to be kept at center point if one wants to make more profit. Animal Husbandry Sector is also not an exception to this. It is not only consumer centric approach, it is also needed to gear livestock production in the direction of consumer demands and market trends. So, it would be more profitable if farmers plan their production from livestock as per demands in the market. At the same time, farmers also need to be certainty about production practices, marketing and price for their products. It requires precision in farming. In this context, following concepts are needed to be taken into consideration.

Utility : Utility is want satisfying power of a commodity or service. A thing is valued by its utility. A product per se may not be valuable. It will become valuable when it has some utility. Eg. We may have sufficient water to drink at home. But, outside, when very thirsty and not having access to water, then one feels utility of water more than at home. Similarly, a product that farmer produces from his livestock, needs to have utility. Of course, most livestock products will have utility. But, to obtain more income and profit, one needs to add utility to the product.

This can be done in 3 types –

1. Time Utility – It is utility ascribed to a particular product at a particular time. Eg. Milk at home may have utility in normal course of time. But, when some guests have come at house, need to prepare tea for them and there is no milk at home. Then, utility of milk will be much more. This utility is fulfilled by use of UTHT packed milk (Eg. Good Life Milk produced by Nandin, KMF, Karnataka). Some farmers are capturing market for Lamps (Diyas) made from Cow dung during Deepavali season.

2. Place Utility - It is utility ascribed to a particular product at a particular place. Eg. At regular places, one may have good access to boiled egg. However, on a trip or tour, where in difficulty in getting good food, need for boiled egg may be more pronounced. Similarly, some livestock products will find better marketing at places like setting up stalls at exhibitions, fairs, festivals etc. Farmers need to make use of such places to increase markting for their products.

3. Form Utility - It is utility ascribed to a particular product in a particular form. Majority of livestock products are bulky and perishable. To enhance efficiency in transportation, their bulkiness may be reduced. Eg. Converting normal milk into condensed milk. To reduce perishability, they can be converted to other forms. Eg. Converting milk into milk powder. Preparation of milk products like khoa, paneer etc. Converting raw dung into dung powder, cakes etc.

Farmers need to understand the demand in market with regard to time, place and form utilities of livestock and livestock products. Plan their production accordingly in order to obtain maximum profit.

In addition to utility, many other factor of market also influence profitability. Some of them are given below.

- Opportunities for Export.
- Opportunities in the fields of Desi Cow, A1, A2 Milk etc.
- Opportunities in Organic Animal Husbandry.
- Growing consumer consciousness for health and high quality products.

- Undertaking increased production seeing to the present demand and good price for the products.
- Harness the large demands during some seasons, festivals and occasions to the benefit of livestock farmers in the form of increased demand and price.

Mere production is not sufficient. The production should go as planned. It should be marketed as per plan. This is called precision farming. Precision farming requires adoption of scientific managemental practices, Novel tools and techniques, market forecasting and marketing.

Precision livestock farming (**PLF**) : It is a set of electronic tools for managing livestock. It involves automated monitoring of animals to improve their production/reproduction, health and welfare, and impact on the environment. (Wikepedia 2021).

Bewley, 2010 defined Precision Dairy Farming as the use of technologies to measure physiological, behavioral, and production indicators on individual animals to improve management strategies and farm performance. A Precision Dairy Farming technology allows dairy producers to make more timely and informed decisions, resulting in improved productivity and profitability. Many Precision Dairy Farming technologies are already being utilized by dairy producers: 1) daily milk yield recording, 2) milk component monitoring (e.g. fat, protein, and SCC), 3) pedometers, 4) automatic temperature recording devices, 5) milk conductivity indicators, 6) automatic estrus detection monitors, and 7) daily body weight measurements. He further mentions that the main objectives of Precision Livestock Farming are maximizing individual animal potential, early detection of disease, and minimizing the use of medication through preventive health measures. Perceived benefits of Precision Livestock Farming technologies include increased efficiency, reduced costs, improved product quality, minimized adverse environmental impacts, and improved animal health and well-being.

Use of these technologies presents an opportunity to improve farm productivity and address future on-farm challenges related to environmental, animal care, and socio-ethical issues. However, greater clarity is needed to ascertain farm system level benefits (monetary and non-monetary) associated with the use of some precision technologies, to minimize investment uncertainty for farmers and to guide technology development. (Gargiulo *et al.* 2018).

In India, few farms and organisations have embarked upon precision livestock farming. Some attempts in this regard are - National Livestock Identification Scheme (NLIS) made the use of radio-frequency identification (RFID) tags, NDDBs Information Network for Animal Productivity & Health (INAPH), BAIF Development Research Foundation, Pune's rapid pregnancy test in cattle, RFID based solutions for identification and farm management.

Precision Farming is to be undertaken at various levels –

1. Precision in production
2. Precision in processing, storage and transportation
3. Precision in Marketing.

1. Precision in Production – This can be obtained by selection of suitable livestock on the farm, following scientific practices in feeding, breeding, health care and other managemental aspects. This also requires consultancy and intervention of a veterinarian. Eg. If a cow needs to give one calf a year, it should be materialized. Wet average is to be 15 liters, it should be materialized.

2. Precision in processing, storage and transportation – For this, proper infrastructure facilities like processing plants, cold storage, transport vehicles are required. These facilities can be at individual, group or mass level.

3. Precision in marketing – At last profitability of a livestock farm to great extent depends on marketing of the products. Products should have appealing and convenient packaging. They should be marketed in time at a profitable price. Eg. Dung, if sold fresh and raw, would fetch a price of about Rs. 0.25/Kg. If the same dung is converted into forms like dry dung powder, dung cake, Lamp (Diya), would fetch Rs. 1 to 4 /Kg. Also, their packaging should be convenient and attractive.

In this way, farmers can plan their production in relation to demand and market situations. Carry on the farm in precision ways. Thus, it would help significantly to increase income of farmers, thus aiding doubling of farmers' income.

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10. GOOD MANAGEMENT PRACTICES FOR DOUBLING FARMER'S INCOME

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Livestock management is an art and not laborious which involves a systematic approach to care for livestock in different phases of their growth. Livestock includes all farmed animals species which provide food in **form of milk or meat. The food products obtained from domesticated animals include beef, pork, meat, egg, milk, chicken** etc. These food products are highly nutritious and rich in proteins and fats.

There are 3 types of existing farming practices 3 types of farming- Intensive, semi extensive and Extensive farming system. Majority are dependent on extensive rearing system. While a few are running Intensive factory-farming system. These are mostly cows, pigs or poultry, etc often reared indoors, typically at high densities.

Doubling of farmers income depends on what existing rearing practices are being followed. When new technologies are introduced, it is possible to obtain higher returns. Hence the farmers or entrepreneurs need to have interest in implementing the new technologies. Further they need to take risk of investing in higher amount towards the new technologies.

The available new technologies can be classified under following 4 Pillars of Livestock Management.

1. Technologies in breeding practices-AI techniques
2. Technologies in feeding practices-Fodder production
3. Technologies in weed control(disease control) practices
4. Technologies in heeding practices (welfare, housing)

1.Technologies in breeding practices-AI techniques

The main aim of breeding is to produce the offspring. It involves inducing to produce ova in females and collection and storage of semen from males. Then the proper time to mate the female at oestrus for a successful conception. Artificial Insemination technique is an age-old method of depositing the artificially preserved semen into the female reproductive tract of animal

for a successful conception. This technology though used in cattle and buffalo is successful only about 40-50% levels due to various reasons. Farmers loose a lot of time in getting conception of cows. This may be due to lack of knowledge on animal physiology of behaviour to identify them in heat and indiscriminate use of drugs in treating the repeat breeder cows. AI is an old known technology; however, it is well established only in case of Cattle and Buffalo species.

A. MEASURES TO REDUCE AGE AT FIRST CALVING

Well grown heifers are the best foundation stock for the dairy. Several factors influence the growth and hence the early age at first calving. They can be classified as External (Non-Genetic) and Internal (genetic) factors. The external factors are under the control of dairyman. It includes the environment of animal, nutrition, housing, care and management. The weight of calf at birth and its periodic rate of weight gain decides its ability to get into puberty and begin its first conception.

The expected normal body weight of heifers is shown below

Age of heifer	**Average body weight in kg**			
	Local cattle	**HF**	**Jersey**	**Buffalo**
At birth	20-25	43	25-30	25-30
6 months	82-102	170	113	110-126
12 months	150-185	307	216	180-236
18 months	200-236	398	282	250-300
24 months	250-274	500	352	350-372
Age at 1st breeding	2-2.5 years	1.5 years	15 months	2.5-3 years
Body weight at 1st breeding(kg) (60% of mature weight)	250	300	280	300

C. CALVING INTERVAL AND MEASURES TO REDUCE CALVING INTERVAL

Calving interval is the time gap between two calvings. Normally all dairy farmers must get one calf a year. This is a measurement of reproductive efficiency.

Components of the calving interval

The calving interval can be divided into two components:

(1) *The calving to conception interval*. This is the time from parturition until the establishment of the next pregnancy. It is this interval that is the main determinant of the calving interval, and is thus the parameter that is usually manipulated in order to try to achieve the target calving interval.

(2) *The gestation period*. This is normally between 280 and 285 days in the cow, the variation being mainly due to genetic influences of both the dam and the sire. It can be shortened to only a limited degree by the artificial induction of parturition.

Factors affecting the calving to conception interval : In order to achieve a 365-day calving interval the calving to conception interval should not be more than 80–85 days. For the purpose of recording reproductive performance on the farm the calving to conception interval is often subdivided into two components: the calving to first service interval and the first service to conception interval. The calving to first service interval depends on

(1) The re-establishment of ovarian cycles after calving,

(2) The occurrence and detection of oestrus and

(3)The herdsperson's planned start of services date, if this is later than (1) and (2).

The first service to conception interval is dependent on (1) the ability to conceive and maintain pregnancy after a given service and (2) the continuation of ovarian cycles and the correct detection of oestrus in those cows that do not conceive to initial services.

Calving interval depend on a combination of genotypic and environmental factors affecting the cows. The ability to conceive also depends on the fertility of the semen used at particular insemination and the effectiveness of the insemination procedure. Therefore, more attention to the detection of oestrus so that 80% of oestrous periods are detected would reduce the average calving to conception interval to around 82 days, close to that required for a 365-day

calving interval. In practice it can be extremely difficult to determine the causes of extended calving intervals. If, for example, the calving to first service interval is extended because oestrus was not detected, this could be due to either:

- a failure of the cow to exhibit oestrus or
- a failure of the stockperson to detect oestrus.

Failure to exhibit oestrus might be due to:

- A lack of ovarian activity
- Abnormal ovarian activity or
- A 'silent ovulation', i.e., ovulation unaccompanied by oestrous behaviour.

Also, if a cow is observed in oestrus more than one cycle length (21 days) after service, this could be due to:

- An intervening oestrous period having been missed
- Abnormal cycle length
- Loss of a conceptus
- Oestrus occurring during pregnancy.

- Similarly, if a cow is inseminated at the wrong time (i.e., not within about one day of ovulation), this could be due to either:
- Stockperson error or

- The cow showing oestrous symptoms at the wrong time. She may or may not be suffering from an ovarian abnormality which would interfere with normal fertility.

Thus the clinician is often faced with a difficult task in trying to unravel the causes of poor reproductive performance.

Reproductive expectancy: Even under ideal conditions, with 100% 'normal' cows and 100% efficiency of oestrus detection, calving rates will fail to reach 100%. At best, only 60–70% of inseminations in cows result in a calf being born, with a large majority of the failures occurring before the second trimester of pregnancy. This is due in part to conception failure and in part to embryonic or foetal death both of which occur in most species. Under experimental conditions,

fertilization rates in cows, as assessed by examination of ova and embryos after slaughter or surgery, have been estimated to be in excess of 90%, although the
figure may well be lower under normal farm conditions. Nevertheless, a high proportion of reproductive failure apparently results from embryonic or foetal death.

Even in the absence of specific fertility problems it is difficult to achieve the 'ideal' 365-day calving interval. All this does not mean of course that calving rates will never achieve 100%. Clearly there must be a specific cause(s) for almost 50% of services to fail. The cause is likely to be multifactorial, involving an interaction between genetics and environment/management. This is currently a hotly debated issue in relation to declining dairy cow fertility.

2. Technologies in feeding practices-Fodder production

Feed costs about 80% of all costs in any type of animal husbandry. Hence farmer need to take care of maximum methods available to utilize the available feed resources.

1. Locally available resources can cut lot of costs in procuring feeds and fodder
2. Roughages refers to the green and dry fodder used in feeding of his livestock
3. Concentrate refers to the balanced ration which provides energy and protein rich feed ingredients
4. Normally 60:40 ratio of Roughage and concentrates are provided for farm animals

Concentrates are very well available with different pricing strategies. Normally concentrates are made of 60% of carbohydrate sources such as maize, jowar, Ragi etc. 20% of brans such as wheat bran, rice bran, Polish etc are provided for bulk making and easy digestion of ingesta. 15-18%% of oil seeds cake provide the source of proteins, 2% of mineral mixture, 1% salt is also added. Generally, this ration provides 16% crude proteins to meet the demands of milking cows. It is very fortunate that milk cooperative societies have come up with sale of such rations in form of Type 1 and Type 2 feeds. Nandini has come up with brand names of Nandini Gold (Type-1, 18% CP) and Type -2 (Nandini Bypass feed, 21% CP). Farmers must purchase these feeds and provide their cows with the ration.

For Non-Pregnant dairy cows-It is enough to provide them a maintenance ration of 2.5kg concentrates per day and about 15-20 kg green fodder

For dry pregnant cows- May be fed 3.5kg maintenance ration concentrates per day and

about 20-25 kg green fodder

For recent calvers-may be fed on basis of milk production that for every 2.5kg milk yield we must provide 1kg concentrate mixture and additional 1 kg concentrates for maintenance and 30-35 kg green fodder is also required.

Hay making:

After harvesting of seeds the plant material is harvested using sickles to make bales of straw. However, it is laborious and time consuming. Tractor mounted baling machines are available these days and can harvest most of the fodder from ground and roll them into bales of 30 kg. These bales can be conveniently stored for years together.

Tractor mounted equipments are available for various farming activities such as

Seed drilling machines for seed sowing. Fodder harvesters are available which can be mounted to tractor in different forms such as front, side and back mounting.

Silage making: silage can be easily prepared with high moisture crops such as Napier and Maize fodder. These days small convenient bags are readily available to make the silage in smaller quantities like 1 tonne or less than this which can be easily prepared and transported and sold.

Chopping of fodder : Farmers make common mistake of offering the fodder unchopped. Since animals do not have capacity to use all fodder as they relish thin leaf and stems the thicker

stem is usually left over. This can be avoided by simple chopping. This has advantage of both giving ample space for storage in manger and also mixes all fodder uniformly. These choppers come in wide varieties and capacities. Further government also provides subsidies for purchase of such machines.

3.Technologies in weed control(disease control) practices

The basic aspect of weed control involves

- Biosecurity measure
- Prompt segregation of sick animals
- Vaccination of healthy animals
- Cleaning and disinfection of premises
- Make regular use of foot bath

Vaccination and treatment

Disease	**First vaccination**	**Annual vaccination**	**Month to be vaccinated**
Foot and Mouth Disease	Calves above 3 months age	Twice vaccination in year	March and August
Hemorrhagic Septicemia	4 months age	Annual	Onset of Rainy season-May-June
Black Quarters	5 months age	Annual	June month
Anthrax	6 months age	Annual	February –March months

The vaccination schedule as provided above is just an indication and suitable modifications

as per availability and species of animals need to be followed.

CALF CARE AND MANAGEMENT-ONE CALF A YEAR GOAL

The Calf form the future of the dairy herd. For maintaining efficiency of production, it is necessary to replace about 20 per cent cows with freshly calved heifer –cows every year. Raising calves is the most difficult operation in a dairy farm. This requires a great deal of management skill, application and constant attention.

The calf is born normally after 9 months of gestation. The gestation period varies with the breed of the cow. Jersey and HF cows have lesser gestation period than the local cows(290 days), while the buffaloes have gestation length of 310 days. Gestation length ranges from 279 to 287 days. For most breeds, 283 days would be common. Cows carrying bull calves tend to have a slightly longer gestation compared to cows carrying heifer calves.

FEEDING CALVES

Feeding of calves after birth*:* Nutrition and management of neonatal calves has a great impact on their later productivity and longevity. It is essential to feed colostrum to the young one immediately after birth in order to ensure development of adequate immunity until it can produce its own antibodies.
Colostrum also has a laxative effect and helps to clear meconium from the gut of the calf. It is a good source of vitamins, minerals, protein and energy. It contains 3-5 times more protein the normal milk and 5- 15 times more Vitamin A. At two weeks of age, the calf should be introduced to good quality green fodder and concentrates, as a calf starter. This stimulates the rumen to grow and function properly.

Calf starter mixture*:* A typical calf starter mixture should have easily digestible good quality low fibre feed. It should contain 22 per cent crude protein and have a TDN of 70-75%. The ingredients used for preparation of calf starter should be of good quality and free from any detrimental adulterants. At the age of 3 months the rumen is developed substantially and microbial digestion takes place in rumen. A palatable ration containing 13-14% CP and 60-62% TDN is required for normal growth. From six month onward the animals can be 12% CP and 58-60%TDN is required at this phase.

Feeding Calf Starter

Calf starters have been evolved for use with limited whole milk. An ideal calf starter contains 20 per cent DCP and 70 per cent TDN. It is a mixture of grains protein feeds, minerals, vitamins and antibiotics. A good calf starter should be palatable enough, rich in energy content and should contain approx. 18-20 per cent protein and fibre less than 7 per cent. Calf starter should be started at 2nd week with 50 -100 grams and continued for 3 months. Regular concentrate given for cows must not be fed to calves as it contains urea which cannot be digested by calves as rumen will not be developed.

Example of Suitable calf starter(100kg)

Maize -35kg (Energy source)
Barley-15kg (Energy source)
Groundnut cake-30kg (protein source)
Wheat bran -10kg (Energy source)
Fish meal -07kg (protein source)
Mineral mixture-02kg
Common salt -01kg
Antibiotic mixture -100g
Vitablend (AB2D2)-15g

(v)Feeding Milk Replacers

Milk replacer is a constituted feed for dairy calves. Milk can also be substituted with milk replacer to make calf raising economical. The following composition of milk replacers has been worked out at NDRI Karnal

Wheat -10kg
Fish meal -12kg
Linseed meal -40kg
Milk -13kg
Coconut oil -7.0kg
Linseed oil -3.0kg
Citric acid -1.5kg

Molasses -10kg

Mineral mixture -3.0kg

Butyric acid -0.3kg

Antibiotic mixture-0.3kg

Rovimix A, B2, D3, -0.015kg

VI. Feeding soya milk supplement

At Puttaparthi Dairy farm, Dr. Prabhudeva had developed unique method of feeding calves. The calves are fed with soya milk in whole milk together in a concentration of 50%. This is prepared by soaking 1kg of soya beans overnight. The next morning, this is grinded using mixer grinder.

The obtained batter paste is diluted in water at ratio of 1:8 litre. It is fed from the age of 15 days after birth up to 3 months @ 3 litres per day .This soya milk is proved to be a great source of protein(45%), which is required by the calves for their normal growth and development. Soya beans are purchased in bulk and stocked. It can be used to improve health of weak calves and heifers also. This helps boost immunity and move towards zero calf mortality.

CALF MORTALITY -CAUSES AND MEASURES

Neonatal calf mortality varies from 8.7 to 64 per cent throughout world (Arif 2012). It has been observed that the calf mortality rate in different farms in India was 30-35%(Thomas et al., 2012). Neonatal calf mortality in the first month of age is accounted to be 84 per cent of the total mortality and is particularly high in the third week of life. This time of life of calf from birth to 21 days age is called as critical period. If the calf survives this period it is possible to keep it healthy through the life.

The causes of calf mortality can be divided into infectious and non-infectious. The infectious causes are diarrhoea and pneumonia caused by bacteria, viruses or protozoa. The

major non-infectious causes are dystocia, improper feeding of colostrum, low birth weight, and poor management practices. Other leading cause of calf mortality are scours and pneumonia.

Still birth means calf death at birth. The major cause for this could be Dystocia or difficulty at calving. Calf birth weight has a highly significant effect on mortality, with low birth weights reducing survivability. Factors which reduce the calf 's ability to fight disease and handle environmental stress are key causes of reduced calf survival rate. It is thus evident that all the management practices which reduce calving problems and increase calf vigour and immune response, have the potential to reduce early calf mortality.

CONCLUSIONS

In summary, records are important since they enable the farmer (1) to monitor the reproductive performance of the herd and of the individual cows and (2) to take action on the basis indicated by the records. Two particular and important uses of records are (1) the recording of all oestrus events, including supplementary signs such as bleeding, to predict approximate dates of expected oestrus and highlight problem cows and (2) the recording of all problems as an aid to culling decisions. All these factors contribute to good management practices for doubling farmer's income.

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