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Cover Page:
Perspective Plan for BAIF’s Dairy Development Programme for
improving the profitability of small farmers through introduction of
latest technologies in animal genetics, breeding and nutrition.

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Dear Colleagues and Friends,

Livestock development is the most reliable livelihood for small farmers and even for the landless. To make it more productive and effective, BAIF is trying to introduce new technologies for the benefit of farmers. The most significant is the introduction of sexed semen technology. Initially, we will use sexed semen from abroad and bring it to India and transfer it for our indigenous bulls. This will also help to conserve and popularize our precious breeds. Another important technology is genome technology. To ensure better evaluation of germplasm and to breed further, we are introducing genome technology in our programme. We have been interacting with several international institutions based in the United States, France and Australia to bring the latest technology and to work on a partnership model.

The BAIF semen freezing laboratory is producing over 80 lakh doses and to strengthen this further, we have established the semen freezing laboratory at Jind, Haryana. This laboratory is fully operational and dedicated to genetic upgradation of Indian breeds of cattle.

For better impact of our programme, we are adopting several new models of cattle development in the field to promote a self-sustainable programme and thereby reduce our dependency on donors. The programme will also include nutrition, breeding to enable farmers to produce better quality animals and make best use of germplasm with proper nutrition and health care.

Thus, we are looking forward and we are confident that with all these emerging trends and technologies, we will be able to address the challenges, growing demand for milk while heavily involving weaker sections of the society in the development programme.

This issue includes articles on these aspects as well as an article on the impact of PPR disease on goats as was highlighted in the National Conference on PPR organized by BAIF in joint collaboration with GALVmed with the support of ICAR and the Commissionerate of Animal Husbandry, Government of India in November 2014 in New Delhi apart from other articles from the field.

With best wishes

Girish G. Sohani
Application of Biotechnology for enhancing Dairy Production

Introduction

Biotechnology can be defined as a technique which uses living organisms or substances from such organisms to make or modify a product, to improve plants or animals or to develop micro-organisms for specific purposes (Rege, 1994). Since 1953 when Watson and Crick published their work on the structure of DNA, opportunities to apply molecular biology techniques in medical, veterinary and agricultural fields have increased at a remarkable rate. Biotechnology in practice typically includes not only genetic engineering, but also closely related tools such as cell culture, monoclonal antibodies, bioprocess engineering and the manipulation of reproductive processes. Biotechnology is widely used in the field of animal science and livestock production. This article summarizes various applications of biotechnological tools for enhancing the production.

Biotechnology and animal reproduction

1. Artificial Insemination: Artificial Insemination with frozen semen has revolutionized cattle breeding all over the world including India. A wider and rapid use of selected males through AI accelerated the rate of genetic improvement. Use of AI facilitated more accurate recording of pedigree and minimised the cost of introducing improved stock. Notable biotechnological applications include research and development in semen biology, cryopreservation, semen sexing and semen quality control applications. Semen sexing technology has given a choice to farmers to select the sex of the desired calves. Use of sexed semen will result in the birth of heifer calves 90% in contrast to non-sexed semen 50%. The additional heifer calves will help to expand the dairy herd at a faster pace.

2. Embryo Transfer Technology: This technology enables amplifying the reproductive rates of high genetic merit and valuable dairy stock. This has a wider scope for production of breeding stock and conservation of indigenous dairy breeds. Advanced ET technologies such as In-vitro fertilization facilitates recovery of
a large number of embryos from a single female at a reduced cost thereby making ET techniques economically feasible on a larger scale. Additionally, IVF makes available embryos suitable for cloning. Production of clones through embryo splitting, nuclear transfer and embryo sexing are some of the advanced embryo manipulation techniques available for application.

This core biotechnological application is being used for the production of transgenic animals, production of clones and gene introgressions which have considerable research, health and pharmaceutical applications. Genetic engineering also provides insights into basic physiological mechanisms for e.g. gene regulation expedites the production of animals with desired production traits and results in the creation of animals with entirely novel properties for e.g. secretion of biomedical substances in milk, completely unattainable by conventional breeding and selection techniques. However, it must be stated that considerable research is still needed as the present success rate is 0.5-1% only.

2. **Genomics and DNA technologies:** The advances in cattle and other livestock genome sequencing projects have considerably impacted the dairy industry in terms of developing Marker Assisted Selection (MAS) and Genomic selection processes. These technologies have large economic impacts in terms of less expensive selection of breeding stock and faster genetic gains in the dairy cattle population. This technology is also providing an opportunity to select less heritable non-production traits in the livestock population. Along with manipulation of reproductive processes, genomic applications could improve disease resistance, milk production, growth, feed conversion efficiency and overall economic merit in the dairy animal population.

**Animal Health**

1. **Disease diagnosis:** Technologies such as monoclonal antibody, ELISA (Enzyme Linked Immunosorbent Assay), PCR (Polymerase Chain Reaction), NAD (Nucleic Acid hybridization), REM (Restriction Endonuclease Mapping), Nucleic acid probe, etc., are revolutionizing the animal health diagnostic field. The diagnostic applications are available for many of the economically important tropical diseases like Foot and Mouth disease, Rinderpest, Peste des petite ruminants, blue tongue, Anaplasmosis, Contagious Bovine Pleuro Pneumonia and Hemorrhagic septicemia.
2. **Vaccine production:** Immunization is the most economical and efficient system available for disease control. Vaccines have conventionally been produced by several methods some of which have become rather static with regard to efficacy, safety, stability and cost. Very effective vaccines against animal diseases such as rinderpest and pig cholera have been in use for more than 20 years and have helped to significantly reduce the incidence of these diseases world-wide. However, vaccines of questionable efficacy also exist. Impotency, instability, adverse side effects, and reversion of attenuated organisms to wild (disease-causing) forms represent some of the problems. However, research strategies for the development of better, cheaper and safer vaccines are constantly being sought. Through the use of monoclonal antibodies and recombinant DNA technologies, it is now possible to define and produce immunogenic components much more rapidly. Some of the novel vaccines for bovines through biotechnological process are those against papilloma virus, viral diarrhea, Brucellosis and Rinderpest vaccines.

3. **Physiology of Reproduction and Growth:** Recombinant bovine somatotropin (BST) is a genetically engineered synthetic analog of the natural growth hormone (Bauman *et al* 1985). Since 1970s, there have been a number of studies on the effects of BST on milk yield, reproductive performance and health as well as its likely effect on humans who consume such milk. Under good management and feeding, regular BST administration to lactating dairy cows increases milk yield by 15-30% and also increases efficiency of milk production. Porcine somatotropin (PST) and recombinant growth hormone stimulatory peptides (e.g. growth hormone releasing factor, GRF) along with BST have been shown to increase growth rates by 8-38% in cattle, sheep and pigs. Although the exogenous hormones have a beneficial effect on animal production, public concerns over the possible residual effects in animal products have led to their ban in most developing countries.

**Animal Nutrition**

1. **Increasing digestibility of low quality forages:** The lignification of the cell walls prevents degradation by cellulase or hemicellulase enzymes. Fortunately, it is possible to use lignase enzyme produced by the soft-rot fungus (*Phanerochaetechrysosporium*) which causes a high degree of depolymerisation of lignin (Tien and Kirk 1983). The enzyme acts like a peroxidase and causes cleavage of carbon-carbon bonds. At present, the levels of the lignase enzyme produced by the basidiomycete fungi are insufficient for the treatment of straw on a commercial scale. However, it is conceivable that the use of recombinant DNA engineering techniques will allow the modification of the lignase genes and associate proteins to increase their efficiency and stability. The lignin gene has been cloned and sequenced from *P. chrysosporium* (Zhang *et al* 1986; Tien and Tu 1987).
2. **Removing anti-nutritive factors from feeds:** A combination of genetic engineering and conventional plant breeding should lead to substantial and cyanogens in legumes, and glucosinolates, tannins) in plant species important as animal feed. Transgenic rumen microbes can also play a role in the detoxification of plant poisons (Gregg, 1989) or inactivation of anti-nutritional factors.

3. **Improving nutritive value of conserved feed:** Genetic manipulation of the fodder preservation microbial inoculations such as *Aspergillus niger*, *Lactobacillus plantarum*, *Pediococcus acidilactic* and *Streptococcus thermophilus* is expected to provide high levels of nutritive value in the conserved feed.

4. **Other technologies aimed at manipulation of rumen microbes** could aid in improving rumen function and reduced methane production.

The above biotechnologies are of prime importance for increasing the productivity of the animals. By applying these technologies, it will help dairy farmers in systematic breeding, feeding and management of various types of dairy animals. These tests allow making decisions on selection to eliminate genetic diseases from herd and to increase profitability by selecting animals with favourable production traits. Continual technological upgradation, use of advanced technologies and strengthening of resources available at farmer level is needed for success of dairy development programmes in future.

**References:**


**Dr. J.R. Khadse**, CRS, Urulikanchan
Indian dairy production system is small holder based and the dairy farmers need to utilize the emerging opportunities (increasing demand for milk) in dairy sector and implement new strategies that will help them to gain economic benefits. Use of sexed semen is one of the strategies that will help them to reap desired economic benefits.

Importance of using sexed semen in the Indian context

Cattle husbandry among Indian farmers in the past was an activity mainly to cater to the agricultural operations in the field. In the course of agricultural mechanization, the draft utility of the cattle is diminishing and the objective of cattle keeping is turning towards dairying. As per the estimates the contribution of the draft animals to the total energy requirements of the farming sector has reduced from the levels of 71% in 1961 to 23.3% in 1991 and keeps declining. This necessitates the production of more number of heifers than is being produced at present. Sexed semen has high potential to deliver the increased number of female calves required to support an expanding dairy sector and allow more smallholders to benefit from improved livelihood by entering into the dairy sector.

The growth of the Indian dairy sector is primarily achieved through growth of the crossbred population, which is growing at an annual rate of around 7.6%. Among the growing crossbred population, males have almost no value or negative value because of the decline in need for draft animals coupled with the socio-cultural ban on cattle slaughter. The crossbred male animals are lost from the system either through early calf mortality, due to neglect, or release into the village commons where they roam unattended. These released bulls pose a constraint for a planned breeding intervention in terms of indiscriminate crossing while grazing and transmission of venereal diseases, while also causing damage and loss to farmer crops and a significant loss of feed resources. They also create problems for general disease control, as they do not undergo regular vaccination. Therefore, a technology,

Impact of Sexed Semen Technology

**Technique**

Purified sperm is sex sorted at Sexing Technologies into X-bearing chromosome (female) and Y-bearing chromosome (male) populations. These purified subpopulations are frozen for future use in artificial breeding.

Sperm is sorted by identifying differences between the X- and Y-bearing sperm. The X-chromosome (female) contains about 3.8% more DNA than the Y-chromosome in cattle. This DNA difference in DNA content can be used to sort the X- from the Y-bearing sperm.
such as sexed semen, that can boost production of crossbred heifers without generating more unwanted males, is desirable for building a profitable smallholder-based dairy sector.

Sexed Semen Technology

Sexed semen is a sorted semen either to contain X or Y sperms and the use of it would produce a desired sex i.e. male or female animal. Semen sexing uses the principle of DNA concentration of X and Y chromosomes. X chromosomes contain 3.8% more DNA than Y chromosomes. The sorting of cells (X or Y) is done using the flow-cytometer technology. Semen sexing technology was introduced in the late 1990’s in dairy industry and since then the technology is slowly expanding.

Benefits of sexed semen

1. Production of replacement heifers

Building up a dairy herd is an important input for a viable dairy operation and acquiring enough heifers for such expansion is a difficult proposition. Use of sexed semen could help hasten this process and the success rate is reported to be as high as 90%. Use of sexed semen will result in the birth of heifer calves 90% of the times in contrast to non-sexed semen, which could result in birth of female calves only in 50% of the times. The additional heifer calves will help to expand the dairy herd at a faster pace.

2. Building a disease free closed herd and improving desirable traits in a faster way:

Expanding the herd size requires procurement of heifer calves from the outside market, which may pose introduction of diseases into the herd, which might jeopardize the objective of maintaining a disease free herd. Internal herd growth using sexed semen might help to resolve this issue. Further the farmer could also ensure that the calves are produced from his own elite dams in a shorter period of time. Production of such genetically superior daughters will result in improving the desired traits in shorter period, resulting in faster genetic progress.
3. **Production of bulls and daughters for progeny testing:**

Using sexed semen from superior evaluated bulls, bull claves could be produced from a population of elite cows for the purpose of progeny testing of these bull claves for genetic evaluation. The young sire program thus will benefit greatly by the use of sexed semen. Similarly production of required numbers of daughters for testing a bull in the field could be achieved from less number of inseminations resulting in use of fewer resources to achieve the same end result.

4. **Reduction in calving difficulties:**

Use of sexed semen tend to produce 90% of female calves, which biologically weigh lesser than the male calves and the percentage of difficult calvings is reduced to almost half. Reduced calving difficulty will help the cows to settle into milking quickly. The costs associated with handling difficult births and loss of calves could be reduced.

5. **Better use of available feed and fodder resources:**

There is considerable shortage of cattle feed, green fodder and dry fodder. These available resources are shared by the dairy animals (low producing indigenous, crossbreds and buffalos) and a large number of male large ruminants. Thus, the high producing dairy animals are deprived of good nutrition to produce milk matching to their genetic potential. The use of sexed semen will result in production of almost 90% females and eliminate the male calves right at birth which will result in increased availability of available feed and fodder resources to the milk producing dairy animals.

6. **Help in climate change mitigation strategy:**

In the recent past, the adverse effects of climate change have been realised the world over. These are mainly due to global warming and production of Green House Gases (GHGs). The dairy industry and the dairy animals and other livestock have been found to be the major agents responsible for CHG emission. The use of sexed semen will result in reducing the dairy animal population by eliminating the birth of male calves on the one hand and helping in production of high milk producing females at a faster rate on the other. The overall reduction in the population will ultimately result in less production of methane and other GHGs.

*Dr. Ashok B. Pande and Dr. Marimuthu Swaminathan, Pune*
Detecting pregnancy, early after breeding, enables animal owners to take up the detected non-pregnant females for oestrus synchronization programme/hormonal/other necessary treatment and subsequent breeding.

In practice per rectal pregnancy diagnosis is carried out at 50 to 60 days after breeding and this increases inter-calving period in animals detected non-pregnant, with production loss of 22 to 32 days. New technology enabled dairy farmers to have pregnancy diagnosis without rectal palpation. By applying the BioPRYN ELISA (enzyme-linked immunosorbant assay) test, not only this loss can be avoided but the female can be treated timely for next breeding. The PSPB (pregnancy specific protein B) present in placenta can be detected in serum of the cow after 28 post-breeding and day-73 post-calving. It confirms viable pregnancy or non-pregnancy. The antibodies raised against PSPB, are used to in BioPRYN- ELISA test to detect PSPB antigen and thereby, pregnancy. To perform this test, an ELISA reader is required and the hormonal kits are required to be imported.

Similarly, a progesterone based milk test is also available which can detect the non-pregnant cows on 18th day post AI. The progesterone is a steroid hormone and is present in the milk 8 times more than in serum. The milk progesterone kit is calibrated to measure low or high progesterone, low means the cow is either in heat or not pregnant. The progesterone test is more accurate than rectal palpation of non-pregnant cows or heat detection of silent estrus. It will be a very new way to reduce the calving interval of Indian dairy cows and buffalos. This is cow side test and can be undertaken by trained personnel. It takes about 1 hr. to get the results. The test material is required to be imported.

These tests are being regularly followed in Europe and USA and are very popular in dairy producers. The pilot studies have already been conducted in BAIF’s operational areas and the results are very much positive. The wide spread dissemination is being planned in other project areas.

**Sub Clinical Mastitis Detection:**

Mastitis, the inflammation of mammary gland remains a serious problem for dairy animals industry and has very serious ramifications for dairy industry worldwide. The adverse economic impact of mastitis on smallholder production systems is also very high leading to economic loss due to low milk production. Prompt detection of subclinical mastitis will preclude severe economic losses to milk producers. Detection of subclinical mastitis requires use of diagnostic kits such as somatic cell count, milk analyzer, microbiological culture and drug sensitivity tests. These methods have many limitations under field condition and are very expensive also the conventional California Mastitis Test (CMT) is cumbersome for field use. Detection of subclinical mastitis at field level can be easily done by using pH based indicator strips like (Mastect strips- Indian Immunologicals, Mastodin Strip Vamso Biotec Pvt. Ltd) as these are unique and simple pen side aid for detection of clinical / subclinical mastitis under field conditions.

*Mr. P. Deshpande, Dr. J.R. Khadse, Dr. A. Kulkarni, Mrs. R. Gade, Mr. S. Totade and Ms. P. Garad, Pune*
**Introduction:**

A systematic genetic improvement programme for our dairy cattle and buffalo population is essential considering the lag in any observable improvement in the milk production potential of our dairy animals. For ensuring a sustainable dairy production, efforts should be made to genetically improve the functional traits like reproduction, longevity and health of our animals. In order to achieve these objectives, the country has initiated genetic improvement programmes for different cattle and buffalo populations through progeny testing and pedigree selection methods in various parts of the country. These methods rely on the accurate phenotypic information collected from the animals’ own performance and their relatives.

Evaluating and selecting bulls through progeny testing programmes were instrumental in bringing a significant genetic improvement in the dairy cattle population throughout the world. Though selection of bulls based on progeny testing has been a proven methodology for achieving a steady genetic progress in the livestock population, it has been a time consuming, complex, tedious and costly activity. With the advent of *Genomic Selection Technology*, there exist a huge potential to select the best breeding animals by delineating the genomic level variations with considerable reduction in cost and time. Genomic Selection Technology considered as an innovative tool in animal breeding, has great potential to complement or replace the traditional progeny testing programme.

**Genomic Selection:**

The basic principle applied in genomic selection is to read the animals' DNA and look for specific variations (Single Nucleotide Polymorphisms - SNPs) at the DNA level and correlating these variations to the trait of interest. The traits are recorded through traditional performance recording methods. Once the relationship is established between the DNA level variations (SNPs) and the trait of interest, then it is possible to select the future breeding animals based on the genomic information alone. A large
number of animals (termed as reference population) with accurate phenotypic records and appropriate statistical tools to estimate the SNP effect are a pre-requisite for implementing an efficient Genomic Selection Programme. Many western countries with advanced dairy breeding programmes were successfully able to adopt this programme quickly due to the availability of accurate phenotypic information, robust statistical models to estimate genomic breeding values and stored genetic material (frozen semen and DNA) which were gathered meticulously over a long period of time.

Advancements in the field of genomic selection technology, currently explore the possibilities of using this technology on a global scale using a combined reference population. We hope that future technological advancements in this field will pave the way to take up genomic selection in our indigenous cattle and buffalo population too.

By using genetic markers it is possible to assess at an early age whether a calf has inherited certain desirable genes from its parents. By doing this, more stringent selection is possible and as a result a larger portion of the test bulls can be promoted to breeding bulls and the larger portion of the selected cows become bull dams / heifer dams.

The benefit of this technology will be greatest in young animals, which do not have progeny yet or while trying to predict the genetic merit of animal for a trait that is not measured on a routine basis such as feed efficiency and resistance to diseases.

Currently, when a young sire is selected to enter as an AI stud, its average reliability (from the parents' proofs) for most of the production traits is only 0.38, because this bull has no progeny and no record. However, if the information from the genomics (genotype information using 50k or 800 K SNP chips) is used to predict the genetic potential, the reliability increases to 0.67. The increased reliability makes it possible to use the young sire at an early age for breeding, which in turn could bring in faster genetic gain in the population at a minimal cost in comparison to ProgenyTesting Programme.

**Prerequisites for Genomic Selection Programme**

There are three types of cattle population:

a) **Discovery or reference population** - This population has both SNP genotype and phenotype information (Estimated Breeding Values derived through progeny testing) are available. SNP effects are estimated (for the trait of interest) using the phenotypic information recorded in this population and a prediction equation is derived.
Prediction equations are very population-specific and hence each of the population requires a separate prediction equation. Experiments are underway to develop prediction equations in multi breed populations, which could be used for population belonging to many groups / breeds. Genomic Estimated Breeding Value (GEBV) combines both the parental average breeding value from pedigree information and the breeding value from genomic information. The advantage of using both sources is that any QTL not captured by the SNP effects may be captured by the parental average or polygenic effects.

Performance recording in dairy cattle population (on a smaller number of animals) as an on-going activity is necessary to identify economically important traits and to estimate the SNP effects to arrive at more accurate GEBVs.

b) Validation population - This is a part of the reference population having both EBVs (derived through traditional breeding programmes like PT) and SNP genotype information available. Based on the prediction equation developed from discovery population, Genomic BVs are estimated for the trait of interest (SNP information + pedigree information). The traditional EBV and the GEBVs are compared and validated for accuracy which is then used for the selection of young candidates from the selected population.

c) Selection candidates - Based on the accuracy of GEBV over EBV derived in validation population, the young animals (bulls) are selected based on the SNP genotypes alone. GEBV is calculated using the prediction equation derived from discovery / training population and the accuracy is assumed to be the one found in validation population.

Proposed Approach

The following approach is proposed for genomic selection under Indian conditions:

Our major impediment in implementing the genomic selection method immediately is the lack of information on breeding values of bulls and cows for different breeds. Through our ongoing progeny testing programmes, we expect to derive accurate records of adequate quantity to estimate the SNP effects in our population in the future. Simultaneously, technological advancements in this field are expected to give us space for utilizing phenotypic information recorded elsewhere (in a developed country cattle population) for developing selection protocols in our cattle population. Over a period of time, once we have sufficient numbers of animals recorded and have the reference population for estimating the SNP effects (genomic breeding values) accurately, it will be possible to predict equations for our populations and use them for predicting genomic breeding values of young bulls and bull mothers.

Dr. Marimuthu Swaminathan and Dr. Ashok B. Pande, Pune
There are 37 recognized breeds of indigenous cattle and 13 breeds of buffaloes in India. Twenty percent of the breedable bovine population is under AI coverage while the rest are covered through natural service with scrub bulls of unknown genetic potential. This is resulting in deterioration of the performance and productivity of some of the important indigenous breeds. There has hardly been any improvement in genetic potential of indigenous breeds over the years. Bulls maintained by the farmers for natural service are not tested for genetic disorders and Sexually Transmitted Diseases (STDs) leading to rapid spread of Brucellosis, Johnes Disease (JD), and Tuberculosis (TB) among bovine population in the country. Furthermore, bulls maintained for natural service are not rotated after every three years leading to inbreeding among bovine population.

Artificial Insemination technique with frozen semen has proved to be the most reliable tool worldwide for genetic improvement through dissemination of superior germplasm. However, this objective can be achieved only if the frozen semen used in AI programme conforms to quality standards. For production and distribution of quality semen, it is important that the bulls used in the AI programme satisfy quality norms; bulls are disease free and semen is harvested and processed in accordance with standard protocols.

One of the key factors affecting productivity is the genetic ability of an animal to produce milk which is an inherited character. Other factors like health, nutrition and management of the animal provide an enabling environment. The breeding bull contributes significantly to the enhanced genetic potential of its progeny for economically important traits like milk production, fat and protein production, fertility, body conformation, etc. Therefore, building an infrastructure for evaluation and production of breeding bulls with high genetic potential for milk production and other important traits is essential for well managed breeding programmes. It is also important to build an infrastructure to transmit the genetic potential of a bull to its progeny through a strong network of AI Centres.

Selection of bulls can be done through methods such as pedigree selection and progeny testing. As the size of the population of most of the indigenous cattle breeds is small, progeny testing is not feasible. Progeny testing is possible only when the size of the population of breeds is large.
With the expansion of the cattle development programme throughout the country, the demand for semen from various Associate Organisations of BAIF and outside agencies is also increasing resulting in shortage of semen doses due to limited number of bulls and bull calves at the semen production station. This has necessitated the establishment of an effective and efficient bull procurement plan. Selection of bull calves from the field based on the availability of the breed in their operational areas is being undertaken with the involvement of Associate Organisations of BAIF in Uttar Pradesh, Maharashtra, Gujarat, Rajasthan, Bihar, Punjab and Andhra Pradesh by selecting elite bull mothers in the field and performance recording of the selected cows and nominated/contract mating of bull mothers, finally selected.

The first step in bull production programme is identification and selection of Cattle Development Centres (CDC) where cows and buffaloes have to be selected and recorded for contract mating. Breed specific areas for crossbreed HFX such as Maharashtra, Uttar Pradesh, Andhra Pradesh and Rajasthan were selected. For JRX - Bihar, Odisha and Andhra Pradesh were selected while for Murrah buffalo breed, Punjab was chosen. Similarly, Gir for Gujarat and Sahiwal for Punjab and UP were finalised. More than 500 elite dams are in bull production programme.

The centres with high density of breedable population and more than three years old, are included in the bull production programme while assuring BAIF's presence for subsequent five years in the area.

The second step is selection of high yielding animals (elite dams) of all the cows and buffaloes having good productive and reproductive efficiency. The animals are selected on the basis of pedigree and milk production. Primary selection criteria in HFX, is cows having peak yield of 25 kg per day, in JYX, 18 kg per day and in Murrah buffalo, 16 kg per day.

The third step is performance recording of selected animals: Each animal is recorded for their productive and reproductive performance. Milk recording is done once a month in the morning and evening on fixed days of the month until the animal becomes dry or completes 10
monthly records. Based on the monthly records, the lactation yield of recorded potential bull mothers is estimated and final selection of top 15-20% cows is done. The finally selected cows are then bred with excellent quality semen of high genetic merit bulls to produce bulls required for semen production. The females produced in the process remain with farmers and are used as bull mothers in future. An agreement is made with all the farmers to ensure smooth implementation of the programme. The bull calves produced are procured from the owners at a remunerative price. Procurement of male calves is done on basis of Minimum Standards Protocol (MSP) set by the Government of India. Bull calves with dams' milk yield more than the prescribed limits of MSP are preferred.

**Physical Examination**

Before procuring bull calves for semen station, a detailed physical examination is done by the technician and veterinarian to ensure that the bulls are free from abnormality and do not display clinical symptoms of any infection or contagious disease.

**Selection of Calf**

The criteria for selection are body colour and breed specific (e.g. HF Black and White). Calves with excellent physical health, free from genetic or congenital defects are selected and tested against TB, JD and brucellosis.

**Statewise Calves procured**

<table>
<thead>
<tr>
<th>State Society</th>
<th>Identified</th>
<th>Rejected</th>
<th>Selected</th>
<th>Reasons for Rejection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bihar</td>
<td>25</td>
<td>10</td>
<td>15</td>
<td>Off colour, physical deformity and other reasons</td>
</tr>
<tr>
<td>Maharashtra</td>
<td>18</td>
<td>12</td>
<td>6</td>
<td>Off colour, physical deformity</td>
</tr>
<tr>
<td>Andhara Pradesh</td>
<td>7</td>
<td>5</td>
<td>2</td>
<td>Off colour, physical deformity</td>
</tr>
<tr>
<td>Rajasthan</td>
<td>13</td>
<td>8</td>
<td>5</td>
<td>Off colour, physical deformity</td>
</tr>
<tr>
<td>Punjab</td>
<td>12</td>
<td>2</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Gujarat</td>
<td>6</td>
<td>3</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Uttar Pradesh</td>
<td>5</td>
<td>5</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>86</td>
<td>45</td>
<td>41</td>
<td></td>
</tr>
</tbody>
</table>

Karyotyping is done for each bull calf to rule out any chromosomal defects. Specific tests are conducted for genetically transmitted diseases like Factor XI deficiency syndrome, Bovine Leukocyte Adhesion Deficiency (BLAD), Citrullinemia, Deficiency of Uridine Monophosphate Synthase (DUMPS)

During the last four years, 90 male calves have been identified and 47 male calves procured from various states. The male calves were rejected due to body colour, physical deformity and pedigree information.

Dr. V.V. Potdar and Dr. A.B. Pande, Pune
Background:
Rural livestock improvement is one of the core activity approach of BAIF to ensure gainful self employment and livelihood sustainability approach at rural level. This activity is not only a tool for income generation and improvement of quality of life of rural population but also an opportunity for dairy population improvement. The approach varies from crossbreeding of rural indigenous (zebu) cows using frozen semen of exotic breed dairy sires (Jersey or Holstein Friesian) for producing crossbreds of high milk potential to conserve and improve indigenous stock through their characterization and genetic improvement by using frozen semen of selected bulls through Artificial Insemination. BAIF dairy cattle improvement activity is spread over to 5.41 million participating rural families through 3996 livestock improvement centers covering 172533 villages spread across more than 12 states in India. Majority of the cow-owners are small and marginal farmers or landless families traditionally adopting crop livestock integrated farming system. Farmers' door AI services aim at understanding farmer/rural problems and working for their upliftment through integrated solutions.

Project history:
Traditionally, bulls have been used by natural service to impregnate females for producing calves. Since one bull is used for providing service to many females, his contribution to improvement becomes more important than that of females. While realizing the importance of bull in transmitting good qualities to its progeny, it was also noticed that the level of impact was much less than desired due to production of a few number of daughters during the year. Invention of Artificial insemination (A.I.) created an opportunity to produce large number of daughters from a bull to create sizable impact of its inheritance to
genetically improve milk production potential of a large number of daughters born and coming into production. Such a programme was launched by BAIF right in the initial establishment years by importing frozen semen of highly merited bulls from Europe and America and thereafter from locally available selected bulls when semen freezing facilities were established and standardized.

Considering the objective of improving milk and overall productive and reproductive performance of rural animals, selection of top class quality of bulls for producing large number of daughters to make desired impact is necessary. Selection of such bulls is made after comparing a large number of bulls and selecting a top few of them to be used extensively. Since bulls themselves do not give milk, the average production of their daughters is considered for comparison. Standard procedures are defined for doing this and the process is known as progeny testing - testing inheritance potential of a bull by testing it from his daughters. First bull testing attempt in BAIF was initiated during the period 1980-85 with financial support from Asian Paints Ltd. During this period, pure Holstein and Jersey breed bulls were progeny tested on the basis of their crossbred daughters produced under farmer conditions. This probably was the first attempt of this sort in the country. Absence of information and experience on many aspects of field recording in the country call for a need to build knowledge on the aspects for fine tuning the recording system to increase accuracy of progeny testing. Based on a request to Indian Council of Agricultural Research New Delhi (ICAR) to financially support an Ad-hoc research scheme on "Progeny testing of crossbred bulls under village conditions", the scheme was sanctioned in the year 1985-86 to BAIF Urulikanchan along with two other universities - one in Punjab and other in Kerala. The objective of the scheme was standardization of the performance recording systems at farmers' herds and to develop progeny testing procedures under filed conditions. The two-year project successfully completed, gave an opportunity to fine tune aspects of milk recording under village conditions. Based on the effectiveness of the approach, ICAR undertook a coordinated effort through its own institute in Meerut in 1987 and a network project on "Field Progeny Testing program of crossbred bulls" was initiated in January 1994 involving the same institutes earlier engaged in the ad-hoc project.

Since then, BAIF field progeny testing programme is a part of the national scheme and presently BAIF unit implements it along with other partners like Guru Angad Dev Veterinary & Animal Sciences University, (GADVASU) Ludhiana, (Punjab), Kerala Veterinary and Animal Sciences University (KVASU), Thrissur, Kerala, and GovindBallabh Pant University of Agricultural & Technology (GBPUPA&T), Pantnagar, Uttarakhand, located in four geographically distinct regions. The programme envisages testing of 30 Holstein Friesian (HF) crossbred bulls of 50-75% exotic inheritance selected on the basis of dam's mature equivalent milk yield of minimum 4500 kg and in each batch at an interval of 15 months. The target is to record 40 daughters per bull spread over these four units. Information on farmer's socio-economic status, herd size, land holding, feeding and housing of animals along with that on animal insemination, pregnancy result, date of calving, data on milk production loss with reasons are being generated.

Results of ongoing project:

The project area is spread over Ahmednagar, Pune and Satara districts of Maharashtra. Out of total 1480 farmers, 40.41% farmers are found educated up to primary level. The percentage of farmers having secondary education is 37.09, whereas the proportion of illiterate cow owners is 9.39%. The percentage of farmers having education graduate and above is 4.59. The average herd size with farmer is found to be 6.04. Generalized composition of herd indicated that more than \( \frac{3}{4} \) share was that of Holstein-Friesian crossbred population (88.77%) followed by Jersey crossbred population (9.63%). The percentage of
non-descript animals was 1.12. Animals' of Gir breed in overall population were found to be below 1 per cent. It was noticed that 55.88 per cent animals were in milking stage and 44.12 per cent were heifers. The milking animals in different lactations included 35.46 per cent from one to three lactations, 18.24 per cent animals 4th to 6th lactation while 1.69 per cent animals were 7th lactation and above. Nearly half (48.79%) of herd owners had permanent or semi-permanent cattle sheds for their animals. The cattle sheds were found constructed from either bricks, stones using clay as a cementing material or re-in-force cement concrete. 20.13 per cent owners had temporary type and 31.08 per cent thatched type of housing to their animals, which was made with wood, dried wheat straws or bajra stovers. None of the animals were kept without shelter. 90.95 per cent of cattle owners were agriculturists and almost all (95.74%) owned land. Nearly 60 per cent farmers had land up to 5 acres and the percentage of farmers having land more than 10 acres was 10.74. Among landholders, more than 2/3rd (69.53%) cattle owners were found cultivating different fodder crops. The proportion of landless and those who did not have land under fodder crop was 4.26 and 30.47 respectively. The fodder crops generally grown are Sorghum, Bajra, sugarcane, lucerne and maize. The dry and green fodders thus available to animals are Sorghum straw, Bajra straw, sugarcane tops, lucerne and maize. In concentrate, farmers are found to feed ready-made feed purchased from market. The thumb rule of concentrate feeding is half kg for every litre of milk produced. Due to non-availability of sufficient land, grazing is not practiced and the animals are managed intensively.

**Impact achieved:**

Before the coordinated project came into actual operation, the test ratings of bulls under progeny test were calculated and an attempt was made to estimate the impact of these bulls on the performance of crossbreds at rural level. For this purpose, the frozen semen doses of these bulls were used in BAIF's operational area to breed field animals. Based on the breeding value of bulls and number of daughters' born and producing first lactation, it was estimated that average genetic contribution of crossbred bulls was 107 kg (Range -117.4 to 652.33 kg.) per lactation. Based on the expected number of daughters produced out of use of frozen semen from these tested bulls and additional milk produced by the daughters in their first lactation, it is estimated that 3222.81 MT of milk was added in the project area.

Since inception of the project, total 231 bulls were put under field testing through 11 bull batches. More than half the fraction of bulls were contributed by BAIF for this national effort. Since the different bull batches are at different levels of delivering results, till December 2014, total inseminations performed were 94,423, out of which 87,232 inseminations (92.38%) were followed for pregnancy confirmation and 39,495 confirmed pregnancies were recorded with average conception rate as 45.28 per cent. From these pregnant animals, 25,101 were followed for progeny birth reports, 11,576 female progenies were born and 4,126 have reached their age at first calving. The average standard lactation milk yield
of crossbreds improved from 2677.56±22.12 kg in 1990-93 to 2964.72±12.88 kg based on observations on 2953 milking crossbreds.

The activity has benefitted in several ways. For example, it has led to initiation, standardization of approach and confirming feasibility of genetic improvement of rural dairy cattle through field Progeny Testing in the country. The activities have started building awareness among the farmers about the importance as well as necessity of field recording, identification of superior bulls has contributed to genetic improvement of field crossbred animals, the status of feeding and management of crossbred animals in field has favorably changed due to frequent visits of recorders and discussions with them and the farmers are now willing to offer their best animals for Embryo Technology to facilitate production of good young breeding bulls. The recording through the project has helped milk producers receive higher market price to their animals and the activity is providing considerable opportunity for identification of superior cows as bull-dams.

**Changing situations and future prospects**

A lot is being talked about the option of Genomic selection in place of Progeny testing. It needs to be borne in mind that the use of this technique in dairy developed countries is built on their long experience of recorded population and its utility in searching strong relationship with genomic structure. Although it is generally successfully applicable to recorded population, theoretical possibility of their being effective in unrecorded population shall have to be tested for effectiveness in the light of limitations of absence of reference population, absence of established structure of field recording, variability of types of animals on which such selected semen is used and further consequences, etc.

Reducing herd size, fodder shortage, surplus animals, repeat breeding, milk procurement price fluctuations, market price of concentrates and health care related aspects, increasing cost of breeding services, increased employment opportunities in livestock sector leading to competition and consequent un reliability of breeding services, absence of organized structure to undertake progeny testing schemes, use of sexed semen etc, are some of the factors hindering adoption of progeny testing programmes and its effective use.

From futuristic point of view, efforts for progeny testing of bulls of Indigenous breeds and that of buffalo breeds need to be intensified. Sporadic global efforts on progeny testing of buffaloes although very well organized, are based on smaller population and at a comparatively lower performance than possible under Indian conditions. The research undertaken by BAIF under financial sponsorship of World Bank and through project holding by ICAR, have revealed a possibility of consolidating the approach of genomic selection in buffaloes only if structure of progeny testing exists and provides information for confirmation of achievements of the selection technology. Both in cattle and buffaloes, the present emphasis on selecting bull for milk yield alone need to be broad based encompassing traits like fat%, yield, type and functional traits, longevity, resistance, etc. Needless to mention, organized structure and institutional arrangements need to be in place for making such an effort more meaningful. Strengthening existing institutions possessing required infrastructure need be supported by the Government for such a concrete approach for improving rural cattle and buffalo population. The initiative taken up by World Bank through project holding by National Dairy Development Board to implement National Dairy Plan and a component of Progeny Testing taken up under the project is an example approach. BAIF being a part of this National Dairy Plan venture, there is good opportunity to consolidate the gains in demonstrating the utility of such an approach.

**Dr. S.B. Gokhale and Dr. R.L. Bhagat,**
Urulikanchan
Livestock sector is an important sub-sector of Agriculture in the Indian economy. It forms an important livelihood activity for most of the farmers, supporting agriculture in the form of critical inputs, supplementing incomes, offering employment opportunities and contributing to the health and nutrition of the household. Adequate supply of feed and fodder is crucial for improving livestock productivity. Livestock in India is maintained largely on crop residues, by-products and grazing lands. India has remained chronically deficit in feed and fodder. As per estimates, the deficit of dry fodder, concentrates and green fodder currently is 10, 33 and 35 percent respectively, which by 2020 is likely to be 11%, 35% and 45% (Report of the Working Group on Animal Husbandry and Dairying, 12th Five Year Plan). The deficit is largely on account of huge livestock population in relation to available feed resources. Moreover in recent years, more emphasis has been given on crossbreeding programme of cattle to achieve high milk production. The feed and fodder needs of these animal is also higher. If these highly genetic potential animals are not fed properly, they will be in a most vulnerable position. Therefore, there is a need for a strong fodder production programme.

The opportunity for expansion of area under fodder crops seems to be very remote and the fodder yields have reached a plateau in most of the fodder crops. However, there is scope to increase forage availability through strengthening breeding programme on forages, their seed production programme and development activities in grasslands/grazing lands/rangelands.

ICAR institutes and the State Agricultural Universities (SAUs) have developed and released a large number of improved varieties in different forage crops suitable for different agro-ecological zones. Nevertheless, under changing climate, resource depletion and emerging technologies the breeding efforts in forage crops need to be elevated. While admitting the breeding objectives in forage crops, we have to accept certain challenges and difficulties.

- In crop improvement programme, germplasm, a source of valuable genes, is important. It has a diversity of adaptive characters and is an invaluable asset to meet the growing needs to increase the production and productivity. As in the case of grain crops, the availability of genetic collection of diverse nature in forage crop species is very limited.

- In many forage crops, the method of pollination, self incompatibility, irregularities in fertilisation and seed setting makes it difficult to maintain the new strain.

- Range grasses are an important source of fodder in grazing and forest lands. These grasses are of Apomictic nature. Apomixis is the asexual production of seeds and is the clone of the mother plants. This nature of range grasses prohibits the hybridisation programme.

- In case of fodder crops, the entire plant is a consumable product for animals and many
anti-nutritional factors such as tannins, oxalates, mimosine, silica, lignin, pricks and long thick dense hair on plant parts reduce the intake and digestibility of the fodder. Advanced laboratory facilities for estimation of such complex ingredients in forages are lacking. Secondly, the conventional breeding methods take a long time to overcome these barriers.

- In India, the use of cereals is mainly for direct consumption mostly by poor in the villages. Many minor millets, viz. Finger millet / ragi (*Eleusine coracana*), little millet (*Panicum miliare*), kodo millet (*Paspalum scrobiculatum*), foxtail millet (*Setaria italica*), barnyard millet (*Echinochloa frumentacea*), proso millet (*Panicum miliaceum*), and savan millet (*Echinochloa colona*), are also important for fodder. The role of foodgrains and especially of coarse cereals in providing balanced nutrition to the livestock for ensuring higher productivity needs no emphasis. There is a need to develop dual purpose varieties in major and minor cereal crops of the country in order to provide enough grain production along with good quality of fodder.

- Biotechnology is a modern tool of crop breeding in the Second Green Revolution. Rapid sequencing genomes of conventional crops is enabled by development of automated instruments and the capacity acquired for handling huge data-sets with advance information technology. DNA markers are used to select novel traits. In forages, biotechnology can be applied to evolve genetically engineered improved varieties tolerant to abiotic and biotic stresses.

**Forage breeding at BAIF:**

- **Germplasm collection:** The richness of diversity is more in the tribal dominated areas where subsistence farming is being practiced. Explorations were carried out to collect unexploited local germplasm of maize from the communities residing in tribal areas of Maharashtra, Gujarat and Jharkhand. Accessions of Lucerne were collected from the traditional Lucerne growing areas of Maharashtra and Gujarat.

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<th>Sr. No.</th>
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<tr>
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<td>5.</td>
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<td>6.</td>
<td><em>Stylosanthes</em></td>
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<tr>
<td>7.</td>
<td>Range grasses and legumes</td>
<td>24</td>
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Variability among the germplasm of Maize for grain characters
Varieties developed:

1. **BAIF Bajra-1**: The composite in forage bajra was developed in the year 2003 and has been tested in the National coordinated varietal trials during Kharif 2004-07. It was notified by the Central Sub-committee on Crop Standards for cultivation in pearl millet growing areas in North West and Central Zone and issued notification No. S.O. 211 (E) in 2010.

2. **BNH-10**: BAIF Napier Hybrid-10 is soft, succulent, leafy and fast growing among the nine hybrids developed from crossing of BAIF Bajra-1 and Napier grass. Hybrid was identified for release in North West, North East, Central and South Zones during Kharif-2012.

3. **BAIF Maize-1**: Maize composite was developed through hybridization involving Maize A. T. and promising germplasm line and further selections to population development. The variety was tested in All India coordinated trials for two consecutive years in 2007 and 2008.

4. **BAIF Lucerne-1**: A variety of Lucerne developed in 2007 through polycross using promising clumps collected from 2nd and 3rd year stands of intensive Lucerne growing areas of Maharashtra. Further polycross progeny was grown and studied for developing superior clonal bulk seed. The variety was tested in All India Coordinated trial for three successive years from 2007-10 and showed superiority over the national check variety i.e. RL 88 by a margin of 5.94% for GFY.

Mr. P.S. Takawale and Prof. J.S. Desale, Urulikanchan

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**BAIF Bajra-1**

The variety is tall and erect growing with dark green foliage, broad leaves, pubescence absent having very long spike distinctly tapering towards tip. It gives 380 to 400 quintals green forage yield and 80 to 90 quintals Dry matter yield per cut in about 55 days. The crude protein content is 9-10 percent. It is moderately resistant to Downey mildew, leaf blast and leaf spot diseases under field condition.

This is a multicut and dual purpose variety. The farmers can take 3-4 cuts for green fodder or after one cut it can be left for grain production. The grain yield at this stage is 10-12 quintals/ha and stover yield of 30 to 40 quintals/ha.

**BNH-10**

It is a perennial type with green foliage, very long and broad semi-drooping leaves without pubescence, quick regenerating and having profuse tillering about 110 to 125 tillers, responsive to fertilizers, non lodging and high yielding. The green forage and dry matter yield is 1160 and 261 quintals/ha/year respectively from 8-9 cuttings. High in Crude protein content i.e. 8.16% and invitro dry matter digestibility- IVDMD i.e. 61.83%
Livestock and importance of animal nutrition: Indian Scenario

In India, we have a large livestock population. Livestock production is the backbone of Indian Agriculture and a source of employment in rural areas since ages. This sector has been the primary source of energy for agricultural operation and a major source of animal protein for the masses. Therefore, India has been home to major draught, milch and dual-purpose breeds of cattle. Per head productivity of Livestock has been very low, mainly because of under feeding and under nourishment. Feed and fodder availability is also one of the important limiting factors for increasing the livestock population. Among the many factors governing the cost of livestock production, feeding accounts for more than 60-70% of the total recurring cost and hence any qualitative and quantitative improvement in this aspect will improve productivity. In livestock rearing, Nutrition is one of the important and crucial factors which determines the profitability.

Diet components of Livestock:

Diet or ration is a feed allowance for animal given during a period of 24 hours. It should be given based on the requirement of the animals and depending on their body weight. Diet of the livestock includes the following:

- **Green Fodder**: Major components of the diet include:
  - Cereal or non-leguminous fodder: Rich in energy contents. For e.g. Maize, Bajra, Sorghum, Napier, Oat, etc. It should include 70% of the total green fodder.
  - Leguminous fodder: rich in protein content. For e.g. Lucerne, berseem, cowpea, etc. It should include about 30% of the total green fodder requirement.
Concentrate mixture: This is the major source of all essential nutrients which can be formulated as per the availability of the ingredients. By-product concentrates commonly available to smallholder farmers are cakes like mustard, groundnut, cottonseed, coconut, sunflower, soybean, rapeseed, safflower, etc., brans like rice, wheat, and maize, milling by-products like broken pulses, readymade concentrate mixtures and non-conventional concentrates including mahua, mango seed kernel, palm kernel, salseed, kokam, etc.

Dry fodder: This is a major source of crude fibre for ruminants essential for proper rumination and digestion. e.g. sorghum kadbi, stovers of maize, bajra and crop residues.

Vitamins and Mineral Mixtures: it is a source of different vitamins and minerals essential for maintenance, production and reproduction purpose. e.g. BAIFMIN-C, VIMICON, chelated mineral mixture etc. Based on the composition, quality mineral mixture should be given daily @60 to 80 gm per day per animal.

Other feed supplements: There are different feed supplements which are essential for different functions. e.g. probiotics, prebiotics, enzymes, growth promoters etc.

Other feed resources: There are other feed resources in the form of azolla, hydroponics, spirulina, bypass protein, bypass fat, etc.

Water: This is an essential component of the diet which is required for different functions of the body. Adlibitum quantity of clean drinking water should be provided to the animals.

Efforts should be made to ensure balanced nutrition for high producing cows because their nutrient requirement is more than the other animals. Following efforts can be followed for providing balanced nutrition to these high producing animals.

Fig. 2: Different methods of Improvement of poor quality roughages
1. Balanced diet:
Balanced diet or ration is a ration which provides essential nutrients to the animal in a proportion and amount which is required for proper nourishment of the animal for 24 hours. It provides nutrients essential for proper nourishment, growth and milk production such as carbohydrates, proteins, ether extract (Fats), crude fibre, vitamins, minerals etc.

2. Methods to improve nutritive value of poor quality roughages
Roughages are poor in nutritive content and characterized by low nutritive value (DCP, TDN etc.), bulkiness, more fibre, high ligno-cellulose complexes, poor digestibility, low mineral content. Their nutritive value can be improved by various methods such as:

   i. **Supplementation with limiting nutrients:** urea molasses lickblocks, green leaves etc.

   ii. **Improvement of nutritive value by treatment**

   a. **Physical methods:** Watering, chaffing, soaking in water, steam under pressure.

   b. **Chemical methods:** Use of alkali, acids, gases, salt, enzymes etc.

   c. **Physico-chemical methods:**
      
      **Urea treatment:** Urea treatment of straw has been shown to benefit its digestibility by both breaking down cell walls and by providing non-protein nitrogen.

3. Adaptation of various technologies to use easily available poor quality roughages in livestock feeding:
Various technologies are being adopted by farmers to ensure the proper utilization of poor quality roughages in livestock feeding such as:

**Complete Feed:** It has benefits such as desired proportion and ratio between various components of complete feed, proper utilization of poor quality roughages, efficient utilization of
nutrients, low cost balanced feed, easy storage and transportation, increases total dry matter intake and milk production improvement in growth and cost effectiveness on labour expenditure.

**Complete feed can be prepared in various forms:**

Mashed form: Mixing of roughages / straws / stovers and crop-residues with oil seed cakes, brans etc or compound feed in proper proportion (roughages and concentrate (60:40 or 70:30)) along with green fodder and offered as wholesome feed as Total-mixed-ration (TMR) to livestock.

Block form: It is compressed by using hydraulic pressure and converting into feed-blocks.

Pellet form: Processing of crop residues and other feed ingredients by using expander - extruder technology to produce complete feed pellets

**Bypass Protein and Fat Technology:**

**By-pass Protein** - This refers to the portion of dietary protein in a feed that is not broken down in the rumen but is digested directly in the small intestine. It has many advantages like better muscle development, feed conversion, digestion, growth during growing phase feed intake, immune function, reduces muscle breakdown etc. **Bypass Fat** includes the fat that escapes Rumen fermentation and passes to the small intestine for enzymatic digestion."

It may be needed to feed high level of fat to ruminant animals especially high yielding dairy cows to meet their high energy requirements. It has many advantages like persistency in milk production, stable body weight, less metabolism disorders, better fertility, higher feed intake etc.

**BAIF's quality input products:**

**Mineral Mixture** produced through BAIF Agro and BioTechnology Pvt. Ltd., Pune:

**BAIF's Fodder Seed Varieties:**

BAIF has developed different varieties of fodder seeds like Maize (African Tall), BAIF Bajra No. 1, BNH-10 (BAIF's Bajra Napier Hybrid 10), Lucerne (RL-88), Sweet Sorghum, Cowpea, Oat, Berseem, etc.

Creating awareness and mobilizing the interest of farmers in animal nutrition is the key factor in livestock rearing apart from management and breeding. As major expenses are incurred on feed and fodder, animal nutrition should be taken up on top priority. Hence, awareness of the farmers about importance of nutrition is to be created so as to increase the profitability in dairy business. A strong extension work is needed for creating awareness about the importance and new trends of animal nutrition amongst the farmers. This can be achieved by organizing trainings, rallies, camps, exposure visits etc. It would help researchers and extension workers to create awareness about animal nutrition the key to success in livestock rearing.

**Dr. Manoj J. Aware, CRS, Urulikanchan**
"I am impressed with the field programme of BAIF with its vast coverage across the country. Whenever I travel in the interior areas of our country, two sign boards are a common sight along the roads. These are the BAIF and BSNL sign boards. Indeed, I am highly appreciative of BAIF’s dedicated service to the farming community."

- Dr. S. Ayyappan

Secretary - Department of Agricultural Research and Education (DARE) and Director General, ICAR
(During the Inaugural Address of the National Conference on PPR Disease on November 28, 2014)
Recent Updates

National Conference on PPR Disease

A National Conference on PPR Disease was organised on November 28-29, 2014 in New Delhi. The focus of the conference was to assess the status of the problem caused by the disease and various initiatives made by different agencies particularly, the Central and State Governments, Research Institutions, Animal Science Universities, Private and Voluntary sectors and Farmers' Organisations and to evolve a strategy for initiating a well-coordinated programme, through the establishment of a National Scientific Forum. The conference was organised with the support of the Indian Council of Agricultural Research (ICAR) and the Department of Animal Husbandry, Dairying and Fisheries, Ministry of Agriculture, Government of India as Co-Organisers along with GALVmed and BAIF. Generous support was received from GALVmed, Intervet International, Indian Immunologicals and Hester Biosciences. The conference was inaugurated by Dr. S. Ayyappan, Director General, ICAR. Prof. Suresh S. Honnappagol, Animal Husbandry Commissioner, Government of India, presided over the function.

Governor of Maharashtra visits BAIF Programme

His Excellency, Shri. Vidaysagar Rao, Honourable Governor of Maharashtra, visited Pimpalkhuta village which had been awarded the status of "Nirmal Gram" in Akkalkuva cluster of Nandurbar district on January 31, 2015. He was accompanied by Shri. Girshaji Mahajan, Guardian Minister, Smt. Hina Gavit, Member of Parliament, Shri. Vijay Gavit, MLA, Shri. Ekanthaji Davle, Divisional Commissioner, Shri. Pradip P, District Collector, Shri. Game, CEO, Shri. Dudhal, Project Officer, ITDP and Shri. Vikaschandra Rastogi, Personal Secretary to H.E. A visit to the BAIF stall led to a briefing about BAIF work in Nandurbar by Shri. Magare while being shown various crafts produced by the SHGs, cashew and anola products and herbal oils. Hands-on demonstration of grafting technique of mahua plant and information about the Germplasm and Seed Conservation bank were also provided.
BAIF has established the

Dr. Manibhai Desai Endowment Fund

for promoting sustainable livelihood in rural India.

We invite generous donors to support this worthy cause by associating with us as our Patrons and Associates.

You can become our Patron by contributing over Rs. 25 lakhs and our Associate by contributing over Rs. 10 lakhs.

New Publication from BAIF

CONTROL OF PPR DISEASE:
CHALLENGES AND OPPORTUNITIES

Proceedings
National Conference on PPR Disease
held on November 28-29, 2014

This book contains presentation and summaries of papers and highlights the current status of PPR Disease in India and strategy for eradication through involvement of all stakeholders.

The publication is available on request.
BAIF Hybrid Napier – 10 (BNH-10)
A New Fodder Variety evolved by BAIF

The Ministry of Agriculture, Government of India has notified BAIF-evolved BAIF Hybrid Napier – 10 (BNH-10) as a crop suitable for cultivation in the states of Punjab, Haryana, Uttar Pradesh, Jharkhand, Odisha, Gujarat, Madhya Pradesh, Maharashtra, Karnataka, Andhra Pradesh, Kerala and Tamil Nadu vide their notification.