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Natural Dyeing of Textiles

Aquaculture: Cooperative and Cluster Farming

Management of Physiological Disorders in Mango

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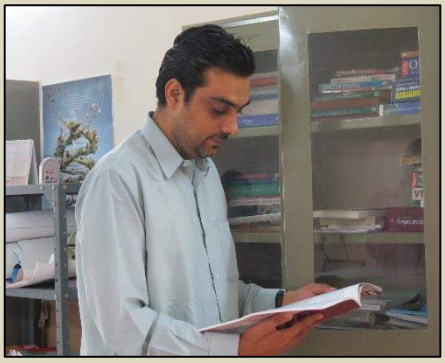
From the Editor's desk...



Agriculture Education in India

India achieved spectacular agricultural growth since 1966. The increase in food grain production from a meagre 51 million tonnes in 1950 to about 245 million tonnes in 2011-12 is a remarkable achievement unparallel in the history of world agriculture. Similar enhancement in production of milk, fish, oilseeds and fruit & vegetables has also been observed. Green, blue, yellow and white revolutions have been responsible for bringing in prosperity to the farming community. The cradle of the success, besides government policies and high receptivity of the farming community, has been the establishment of institutions of higher agricultural education. These institutions developed new breed of skilled human resource who were instrumental in not only generating new technologies but also in their assessment, refinement and dissemination to the farming community.

Agricultural education system in India distinctly evolved during pre independence era on the British system of education and post-independence era on the US Land Grant Colleges pattern. The available records show that the earliest agriculture college was established at Saidapet (near to present day Chennai city) in 1877. It was followed by setting up of the first Veterinary College in the undivided India at Lahore (now in Pakistan) in 1882. A three-year Veterinary Science course was started in 1884 at Parel, Bombay. It was in 1889, when real beginning of research started with the launch of an Imperial Bacteriological College at Poona. Besides those mentioned above, some more Veterinary Colleges were founded at Calcutta (1893) and Madras (1903).

Lord Curzon - the then Viceroy of India (1898-1905), realized that the government must pay priority and urgent attention to the development of agriculture. Thus, in the beginning of the 20th century, an Agricultural Research Institute each at Pusa in Darbhanga district (now Samastipur) of Bihar (subsequently named Imperial and now

Indian Agricultural Research Institute) and Coimbatore in the present-day Tamil Nadu were established in 1905. Agricultural 5 Colleges were also established at Kanpur, Lyalpur (now in Pakistan) and Nagpur in 1906, Poona in 1907 and Sabour in 1908. Following the initiation of the graduate level programmes by the Agricultural Research Institute beginning 1905, a two-year postgraduate diploma, also known as "IARI Associateship", was initiated at the then Imperial Agricultural Research Institute, Pusa in 1923. On the recommendations of the Royal Commission on Agriculture (1928), Imperial (now Indian) Council of Agricultural Research was created in 1929 to provide further impetus and support to the already existing Agricultural Research Institutes. In the early 1930s, postgraduate programmes leading to M.Sc. and Ph.D. degrees in agriculture were started. The Madras Veterinary College with affiliation from the University of Madras in 1936 launched a 4-year B.V.Sc. course. Further thrust to veterinary education was given with the establishment of five more veterinary colleges between 1946 and 1948 at Mathura (1946), Rajendra Nagar (1946), Jabalpur (1948), Jorhat (1948) and Hisar (1948). Before the start of these veterinary colleges, a degree courses in agricultural engineering began in the early 1940s at the Allahabad Agricultural Institute (now a deemed to be university). By 1947 - the year of India's independence, there were 17 agricultural colleges affiliated to general universities.

After independence, Govt. of India appointed University Education Commission under the Chairmanship of Dr. S. Radhakrishnan to review higher education and suggest measures for meeting the future requirement of the country. The Commission recommended that Agricultural Education be recognized as a major national priority so that the country is able to feed itself. The Commission recommended establishment of autonomous rural universities and accord them same facilities as were available to other universities including substantial grant-in-aid from the centre for development. Based on Dr. S. Radhakrishnan Commission on University Education and subsequent two Joint Indo-American Study Teams (1955, 1959) recommendations, first agricultural University was set up in Pantnagar in 1960, which paved the way for establishment of agricultural universities in other states.

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Natural Dyeing of Textiles

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Dyeing is an ancient art which predates written records. It was practised during the Bronze age in Europe. Primitive dyeing techniques included sticking plants to fabric or rubbing crushed pigments into cloth. The methods became more sophisticated with time and techniques using natural dyes from crushed fruits, berries and other plants, which were boiled into the fabric and gave light and water fastness (resistance), were developed. Some of the well known ancient dyes include madder, a red dye made from the roots of the *Rubia tinctorum*, blue indigo from the leaves of *Indigofera tinctoria*, yellow from the stigmas of the saffron plant, and logwood, an extract of pulp of the logwood tree. A bright red called cochineal was obtained from an insect native to Mexico. All these produced high-quality dark colours. Until the mid-19th century all dyestuffs were made from natural materials, mainly vegetable and animal matter.

Today, dyeing is a complex, specialised science. Nearly all dyestuffs are now produced from synthetic compounds. This means that costs have been greatly reduced and certain application and wear characteristics have been greatly enhanced. But many practitioners of the craft of natural dyeing (i.e. using naturally occurring sources of dye) maintain that natural dyes have a far superior aesthetic quality which is much more pleasing to the eye. On the other hand, many commercial practitioners feel that natural dyes are non-viable on grounds of both quality and economics. In the West, natural dyeing is now practiced only as a handicraft, synthetic dyes being used in all commercial applications. Some craft spinners, weavers, and knitters use natural dyes as a particular feature of their work.

In many of the world's developing countries, however, natural dyes can offer not only a rich and varied source of dyestuff, but also the possibility of an income through sustainable harvest and sale of these dye plants. Many dyes are available from tree

waste or can be easily grown in market gardens. In areas where synthetic dyes, mordants (fixatives) and other additives are imported and therefore relatively expensive, natural dyes can offer an attractive alternative. The knowledge required for sourcing and extracting such dyes and mordants is, however, often not available as extensive research work is required to identify suitable plants, minerals, etc. In some countries, such as India, Nigeria and Liberia, where this research has been carried out, or where there exists a tradition of natural dyeing, natural dyes and mordants are used widely.

Types of textiles suitable for dyeing

Natural dyes can be used on most types of material or fiber but the level of success in terms of fastness and clarity of colour varies considerably. Users of natural dyes, however, tend to also use natural fibers, and so we will look in more detail at this group. Natural fibers come mainly from two distinct origins, animal origin or vegetable origin. Fibers from an animal origin include wool, silk, mohair and alpaca, as well as some others which are less well known. All animal fibers are based on proteins. Natural dyes have a strong affinity to fibers of animal origin, especially wool, silk and mohair and the results with these fibers are usually good. Fibers of plant origin include cotton, flax or linen, ramie, jute, hemp and many others. Plant fibers have cellulose as their basic ingredient. Natural dyeing of certain plant based textiles can be less successful than their animal equivalent. Different mordanting techniques are called for with each category. When a blend of fiber of both animal and plant origin is being dyed, then a recipe should be chosen which will accentuate the fiber which is required to be dominant.

Equipment needed for home dyeing and very small-scale commercial dyeing

Most equipment needed for dyeing fabrics at home, or at the very small-scale commercial level, can be found in almost any market place throughout the world. The following is a list of the equipment requirements and a brief explanation of their use.

- **Heat source:** This can be any type of cooking stove; gas, wood, kerosene, charcoal, electricity. This is used for heating the liquid used during mordanting and dyeing.
- **Pestle and mortar:** Used for milling the natural dyes.
- **Mordanting and dyeing pans:** Stainless steel or enamel pans are the

most suitable for dyeing. The size of pan depends upon the quantities of fabric that will be dyed. Do not use pans made from copper, aluminium or iron, unless absolutely necessary, as these metals have properties which can change the colour of the dye.

- **Tirring rods:** Stainless steel or glass rods are best as they can be cleaned and used for different colour dyes. If wooden stirring rods are used then there should be a different spoon for each colour.
- **Thermometer:** This is used to measure the temperature of the liquid during mordanting and dyeing. A long thermometer (to reach the liquid at the bottom of the pan) is preferred, with a range of 0 – 100°C (32 – 210°F).
- **Measuring jugs:** These are used to measure the quantities of liquid called for in the recipe.
- **Storage containers:** Used for storing the dyestuffs and mordants. Large glass and plastic jars are ideal. Some mordants and dyes are sensitive to light and should therefore be stored in sealed light-proof containers.
- **Plastic bowls and buckets:** A variety of plastic bowls or buckets of varying sizes are useful when wetting or rinsing fabrics.
- **Strainer**: Used for straining the liquid off the dyestuff in the dyebath.
- **Weighing scales:** Used for obtaining the correct quantities as specified in the recipes. A scales with metric and imperial measurement is useful as conversions from one system to the other are not then needed.
- **Protective equipment:** Gloves for holding hot pans will prevent burns. An apron will protect your clothing. Rubber gloves will prevent skin irritation caused by mordants.

Dyeing of textiles Practical Action

It will also prevent from dyeing ours hands. A face mask can cut down the amount of fumes or powder inhaled during the dyeing process.

Mordants

Few natural dyes are colour-fast with fibers. Mordants are substances which are used to fix a dye to the fibers. They also improve the take-up quality of the fabric and help improve colour and light-fastness. The term is derived from the Latin mordere, to bite.

Some natural dyes, indigo for example, will fix without the aid of a mordant; these dyes are known as 'substantive dyes'. Others dye, such as madder and weld, have a limited fastness and the colour will fade with washing and exposure to light. Traditionally, mordants were found in nature. Wood ash or stale urine may have been used as an alkali mordant, and acids could be found in acidic fruits or rhubarb leaves (which contain oxalic acid), for example. Nowadays most natural dyers use chemical mordants such as alum, copper sulphate, iron or chrome (there are concerns, however about the toxic nature of chrome and some practitioners recommend that it is not used).

Mordants are prepared in solution, often with the addition of an 'assistant' which improves the fixing of the mordant to the yarn or fiber. The most commonly used mordant is alum, which is usually used with cream of tartar as an additive or assistant. Other mordants are:

- Iron (ferrous sulphate)
- Tin (stannous chloride)
- Chrome (bichromate of potash)
- Copper sulphate
- Tannic acid
- Oxalic acid

Using a different mordant with the same dyestuff can produce different shades-

- Iron is used as a 'saddener' and is used to darken colours.
- Copper sulphate also darkens but can give shades which are otherwise very difficult to obtain.
- Tin brightens colours.
- Tannic acid, used traditionally with other mordants, will add brilliancy.
- Chrome is good for obtaining yellows.
- Oxalic acid is good for extracting blues from berries.
- Cream of Tartar is not really a mordant but is used to give a luster to wool.

Mordants are often poisonous, and in the dye-house they should be kept on a high shelf out of the reach of children. Always use protective clothing when working with mordants and avoid breathing the fumes. The mordant can be added before, during or after the dyeing stage, although most recipes call for mordanting to take place prior to dyeing. It is best to follow the instructions given in the recipe being used or experiment on a sample before carrying out the final dyeing. These chemical mordants are usually obtained from specialist suppliers or from chemists. Where this is prohibitive due to location or cost, natural mordants can be used.

Natural dyestuffs

Dyestuffs and dyeing are as old as textiles themselves. Nature provides a wealth of plants which will yield their colour for the purpose of dyeing, many having been used since antiquity. In this section we will look at some of these naturally occurring dyes, their source and the colours they produce. Later in the brief we will look at the application of the dyes to textiles. Almost any organic material will produce a colour when boiled in a dye-bath, but only certain plants will yield a colour that will act as a dye. Natural dyes fall into the following categories:

- Leaves and stems
- Twigs and prunings
- Flower heads
- Barks
- Roots
- Outer skins, hulls and husks
- Heartwoods and wood shavings
- Berries and seeds
- Lichens
- Insect dyes

The process of dyeing- Application of the Dye

Dyeing can be carried out at any of the following stages in the textile manufacturing stage:

- The fibers can be dyed before they are spun. Fiber dyeing provides a deep penetration of the dye into the fiber, giving even colour and excellent colour-fastness.
- The yarn can be dyed after spinning but before the product is woven or otherwise fabricated. This is called package dyeing.
- Before the fabric is finished, it can be dyed in lengths (piece dyeing).This

process allows manufacturers the opportunity to produce fabrics in their natural colours, and then dye them to order.

- In cross-dyeing, fabrics of two or more fibers can be dyed so that each fiber accepts a different dyestuff and becomes a different colour, through the use of appropriate dyestuffs for each fiber.

It is essential for the correct identification of the fiber or other fabric to be made before dyeing commences.

Methods of dyeing

There are a number of methods of applying dye to a fabric. Although the most common method used for applying natural dyes is the vat method, there are techniques which have been developed to allow patterns to be incorporated during the dyeing process. It is worth bearing in mind that using natural dyes is a complex art and the skills required for using natural dyes are learned over many years.

Vat Dyeing

In the simplest form of dyeing a textile material is immersed in dye and gradually brought to the boil. Alternatively the fiber is allowed to sit and soak for several hours or days. During this period, agitation is necessary to allow full penetration of the textile by the dyestuff. Depending on the type of fabric and dyestuff used, certain salts or acids may be added to assist absorption of the dye. The principal difficulty in dyeing mixed yarns and fabrics is to achieve the same colour in both fibers. Cotton fibers may, for instance, absorb dyes rapidly, while the wool fibers will have to be boiled over an extended period to reach the same depth of shade. This could lead to significant damage to the material. In this case a chemical compound would need to be used to restrain the rate at which the cotton fiber takes up the dyestuff.

Batik

Batik is a starch resist-dyeing process, developed on the Island of Java in modern-day Indonesia. Colour is prevented from reaching certain areas of a fabric by covering these areas with molten wax. The fabric is starched prior to the design being drawn upon it. The wax is applied with a type of cup with a fine pouring spout, usually made of copper. The technique has been developed to a high art form in Indonesia from where it is exported to many parts of the world. Batik paintings, as well as sarongs and lengths of fabric, are produced. When the fabric is dyed, all waxed areas resist the dyestuff. The

wax is then removed by placing the fabric in boiling water. For patterns with many colours the same procedure is repeated until the full design is completed.

Tie-dyeing

Tie-dyeing is another popular artisanal dyeing technique. In this resist-dyeing process, waxed thread is tightly tied around the areas chosen to resist the coloured dyestuff, and the fabric is dipped into the dye. The waxed thread is then removed and the fabric dried. This process can be repeated for each colour to be added.

Conclusion

Use of compatible natural dyes for colouring natural eco-friendly textiles in variety of soothing / uncommon shades with eco-friendly mordants and finishing agents are the most desirable product of the customers for future. The non-reproducibility and poor colour fastness etc, have been partly solved by many researchers' continuous efforts in this endevour. So, a textile dyer must know the effects of variability for extraction, mordanting and dyeing and should follow only the standardized recipe for selection fibre-mordant, natural dye system to get reproducible colour yield and colour matching besides to follow different eco-friendly ways to improve colour fastness to a possible extent.

Scrotal Circumference: Vital For Optimum Fertility in Dairy Bulls

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Fertility of bull can be defined as ability to impregnate females. Adequate number of genetically superior and fertile dairy bulls are required to cover the breedable females in a herd. Having fertile and healthy dairy bulls in a herd can ensure higher productivity as well as milk production, transmission of desired genetic traits, reduces transmission of diseases and will improves life time fertility of the herd. As per 18th All India Livestock Census (2008), only 10% cattle bulls and 4% buffalo bulls are used for breeding purpose and how many among them are healthy and fertile is still a question, which needs to be answered. Bull is considered more than half of the herd as the total genetic gain obtained through sire-to-sire path and sire to dam path is about 64 percent. Estimating the breeding value of sires with higher accuracy and the production of a larger number of daughters can make contributions as genetically superior replacement stock for the next generation (Basu, 1996). Unfortunately, not much emphasis is given to fertility traits as an effective selection tools for genetic improvement among dairy bulls. Prior to put the dairy bulls in a breeding programme, they are generally tested for their phenotypic breeding soundness. Scrotal circumference is one of the most important criteria for breeding soundness evaluation among dairy bull. The largest diameter (cm) of scrotum is taken for breeding bulls using measuring tape. It is to be noted that the testicles of bulls be confined closely in the bottom of the scrotum, so that the measurement should be accurate with highly repeatability. Many researchers have shown that scrotal circumference is an accurate predictor of sperm production in young bulls. Generally scrotal circumference of indigenous and cross bred breeding bulls ranges from 30 to 34 cm (Mukhopadhyay *et al.* 2010). Reports indicate that increased scrotal circumference is associated with earlier age at puberty, increased semen production and improved semen quality. Scrotal circumference of a bull also

provides an important indication of his potential genetic merit for several important fertility traits. According to Sethi et al. (1989) multitude of studies have reported that probability of the bull having satisfactory semen quality increased greatly as scrotal circumference increased from 30 to 38 cm.

Fig1: Measuring Scrotal Circumference

Scrotal circumference is highly correlated to total sperm output and moderately correlated to normal sperm morphology. Bulls with larger testes will produce more normal sperm cells. Testes size and scrotal circumference has a very high heritability estimate about 0.68 (Latif et al., 2009). This means it is an easy trait to select for and rapid progress can be made in selecting bulls that will produce more normal sperm cells. Selecting bulls with large testes also has a fortuitous spin-off in improving female fertility. Many workers reported that has shown that female relatives of bulls with larger testes reach puberty at a younger age. Increased scrotal circumference also has a favorable relationship with female fertility/ daughter fertility, both in terms of earlier age at puberty, earlier return to oestrous and shorter days to calving (Chacon et al., 2002). Through selecting bulls for testes size as well as growth traits, reduced the age of puberty whereby 80% of the heifers reach puberty by 10-12 months of age and nearly 100% by breeding age at 14-15 months. There is a positive relationship between scrotal circumference and yearling weights so growth traits are not compromised when selecting for both fertility and growth rate. Table (1) illustrates the age wise minimum scrotal circumference (SC) for a bull to pass breeding soundness exam (BSE) in breeding programme, recommended by Society of Theriogenology, 2014.

Table 1: Recommended Scrotal Circumference

Age	Minimum SC(cm)	Good SC(cm)
<15 months	30	>34
15-18 months	31	>36
18-21 months	32	>37
21-24 months	33	>38
>24 months	34	>39

There is great variation present in scrotal circumference between different breeds of dairy bulls. Measurement of thousands of English and European bulls have shown that yearling bulls should have scrotal circumference of at least 30 cm and by 20 months of age have a scrotal circumference of at least 32 cm. Brahman breed bulls will have smaller testes at the younger ages and they will reach maturity comparatively at an older age. Brahman breed bulls will have adult scrotal circumferences similar to other beef breeds (Chenowth, 2009). Selecting for genetically larger scrotal size will also select bulls whose daughters reach sexual maturity quicker. Since early maturity is a difficult trait to assess in a commercial situation, an indicator such as scrotal size which is much easier to measure is a valuable tool. Scrotal size correlated with daughters age at maturity, but no reports of correlation with daughters fertility were available. Therefore, we recommend that scrotal circumference is a trait that animal breeders should include in their bull selection criteria.

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Pet Birds Born Zoonosis: An Overview

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The term "Pet bird "designates birds housed and bred for an exclusively ornamental use. This category includes mainly Passeriformes (e.g. canaries, finches, and sparrows) and psittaciformes (parrots, parakeets, budgerigars, love birds). It is important to remember that there are several pet bird diseases which can also make humans sick. Infection usually occurs when a person inhales dried droppings or nasal secretions from infected cockatiels, parakeets, and other parrot-like birds. These animals, however, are potential carriers and/or transmitters of zoonotic diseases. Some of them could have an important impact on human health, like chlamydophilosis, salmonellosis or even highly pathogenic avian influenza A H5N1. This review paper, although non exhaustive, aims at enlightening, by the description of several cases of bird-human transmission, the risks encountered by bird owners, including children.

Bacterial diseases

1. Avian Tuberculosis

Mycobacterium avium is the causative agent of avian tuberculosis is found worldwide. Affected birds usually have vague symptoms, such as loss of weight despite a good appetite, dull feather coloring, increase in urine output, diarrhea and anemia. The disease can spread through the air or through the feces from infected birds. In people, the disease causes respiratory infections, swelling of lymph nodes below the jaw and even widespread disease in people with weakened immune systems. This disease can be hard to treat in both birds and humans, and can be fatal for some.

2. Campylobacteriosis

Campylobacteriosis is caused by *Campylobacter jejuni* a gram negative, bacteria especially in psittaciforms (parrots) and passeriforms (finches and canaries). This bacterial organism lives in the small intestine and colon and may be isolated from clinically ill as well as clinically normal birds. Free-living wild birds maintain and spread the disease by the fecal-oral route. Clinically ill birds develop hepatitis, lethargy, loss of appetite, weight loss and yellow diarrhea.

People may become ill from eating contaminated poultry and poultry products. People develop cramps, fever, diarrhea and headaches within 2 - 5 days of exposure. Pregnant wormen, debilitated individuals and the immuno-compromised are at the greatest risk.

3. Chlamydiosis

One of the most threatening zoonotic diseases transmitted by birds to humans is chlamydophilosis also known as chlamydiosis, ornithosis, psittacosis or parrot fever), caused by the intracellular bacterium *Chlamydophila psittaci*. Psittacine species are highly sensitive to this pathogen. The diseases can be transmitted to humans through feces and infectious particles in the air. In people, the disease causes flu-like symptoms of fever, chills and headache. If left untreated, Psittacosis can cause liver and kidney damage or even meningitis. Highly contagious, Chlamydiosis requires swift and vigorous antibiotic treatment as well as placing birds under quarantine to prevent the spread of infection.

Viral diseases

1. Avian Influenza

Avian Influenza virus is a well-known and deadly zoonotic disease caused by highly pathogenic H5N1 strains. It is transmitted mainly through contact with the infected birds. Although pigeons are affected by bird flu it is not a common threat to captive pet birds. Waterfowl is the major host become infected and transmits the virus to other birds and people.

2. New Castles Disease

Newcastle disease is caused by an avian paramyxovirus-1 and can be seen in birds both wild and domestic. Transmission is mainly by aerosol but contaminated food, water and equipment can also transmit the infection within bird colonies. Pathogenic strains produce anorexia and respiratory disease in adult birds.Young birds often shows neurologic signs. In humans the disease is characterized by conjunctivitis, fever, and respiratory symptoms.

3. West Nile Fever

West Nile Fever is an emergent vector-borne zoonosis in which house sparrows play a key role as main and amplifying reservoir hosts. The virus responsible for this disease is a flavivirus (Flaviviridae). The virus is isolated from numerous passeriform species, including canaries, as well as psittacines. Most of the time Birds are sub-clinically affected, but can, however, develop a clinical form of the disease with ocular and neurologic symptoms. This virus is transmitted by arthropod vectors

mainly mosquitoes of the Culex pipiens. In humans Virus mainly affects the central nervous system, and infection usually results in mild flu-like symptoms. However, in severe cases, infection with West Nile virus can be fatal.

Fungal diseases

1. Histoplasmosis

It is an important systemic fungal disease caused by *Histoplasma capsulatum* and grows in soil and material contaminated with bat or bird droppings. Spores become airborne when contaminated soil is disturbed. Breathing the spore causes infection. Histoplasmosis basically is a pulmonary or respiratory disease, but may extend to the liver, lymph nodes, and spleen; it may disseminate to the blood and bone marrow and be fatal. The victim frequently has chills and fever to 105 degrees, night sweats, chest pains, and fatigued. The organism may lodge in the eye to cause ocular histoplasmosis.

2. Cryptococcus

The disease is caused by systemic pathogenic yeast called *Cryptococcus neoformans*, which is found worldwide. Though uncommon in pet birds, infection can cause diarrhea, paralysis, nervous-system signs and masses with a gelatinous consistency. Humans can contract this disease when they inhale the dust from dried droppings (most commonly from pigeons). Infection in people can be quite serious leading to meningitis, encephalitis (brain inflammation) or respiratory symptoms.

Considering the major health impact on the population, including children bird-keepers should be aware that they can contract certain illnesses from their birds. The frequency of disease transmission from birds to humans is low, but the very young, the elderly, and those with compromised immune systems should be cautious. Pet bird diseases with zoonotic potential should not be neglected or underestimated. Prevention of most of these diseases, therefore, simply involves proper hygiene and sanitation. Wearing a face mask to avoid inhaling bird dust is also recommended.

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Coastal Aquaculture:

Opportunities and challenges in Gujarat

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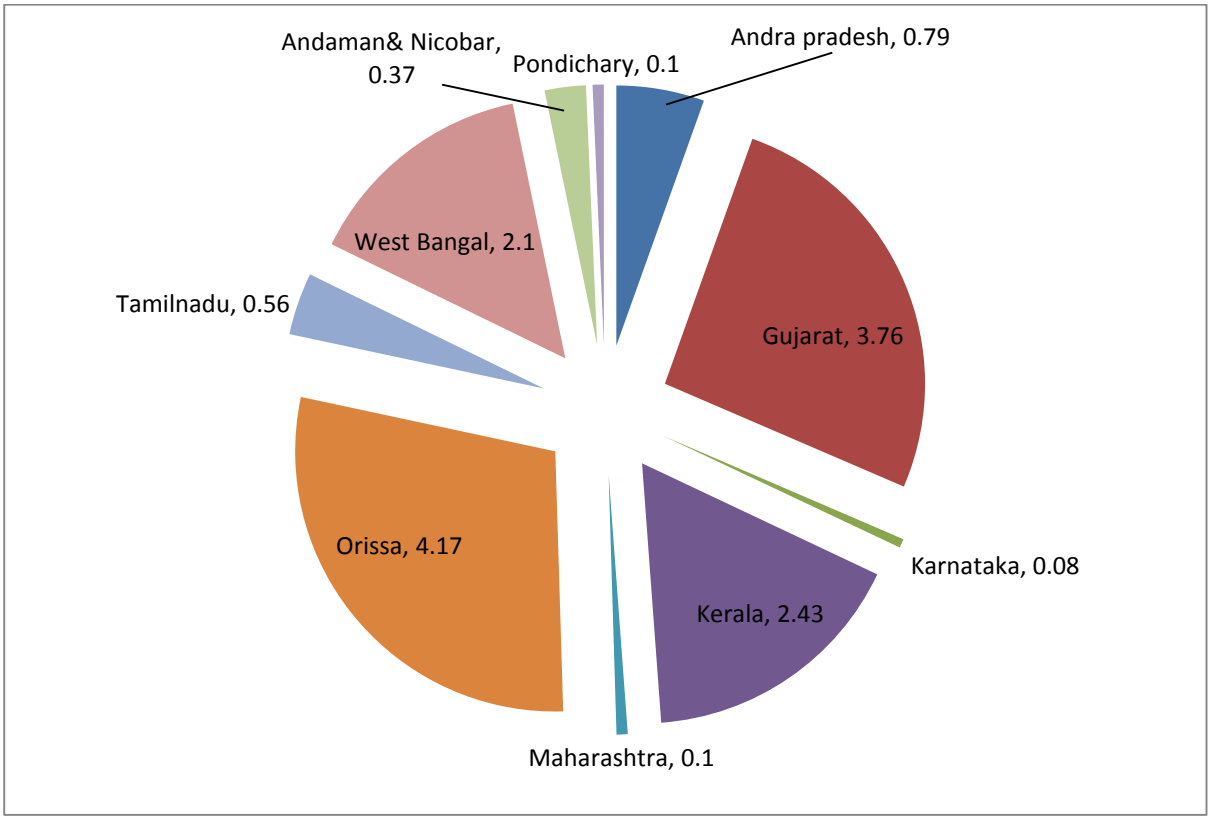
Aquaculture has been the fastest growing sector for over a decade. Coastal aquaculture is one-among ancient avocations of man. Recent developments in coastal aquaculture in this region signify the beginning of a new era in fisheries development with a thrust on the culture fisheries. With large availability estuarine and brackish water resources in the state provide huge scope in coastal aquaculture development. Communication is an essential part of scientific life and many would regard research that is not passed on to others as being incomplete. Hence this article is written to bridge current scenario with opportunities as well as challenges in coastal aquaculture development of Gujarat state.

Aquaculture remains a growing, vibrant and important production sector for high protein food. The reported global production of food fish from aquaculture, including fin fishes, crustaceans, molluscs and other aquatic animals for human consumption, reached 60 million tonnes in 2010 with estimated total value of US$119 billion (FAO, 2012). In the last three decades (1980–2010), world food fish production of aquaculture has expanded by almost 12 times. The contribution of aquaculture to the total production of capture fisheries and aquaculture has continued to grow, rising from 34.5 % in 2006 to 36.9 % in 2008. In the period 1970–2008, the production of food fish from aquaculture increased at an average annual rate of 8.8 %, while the world population grew at an average of 1.6 % per year. Coastal aquaculture is one among the ancient avocations of man. The Romans and the Japanese are known to have practised oyster culture in its primitive form for several centuries and the South-East Asian countries have been carrying out fish culture for at least five centuries now. India have traditional forms of aquaculture, it still remains at subsistence level, almost as it was in the distant past. But the recent developments in coastal aquaculture in this region signify the beginning of a new era in

fisheries development with a thrust on the culture fisheries.

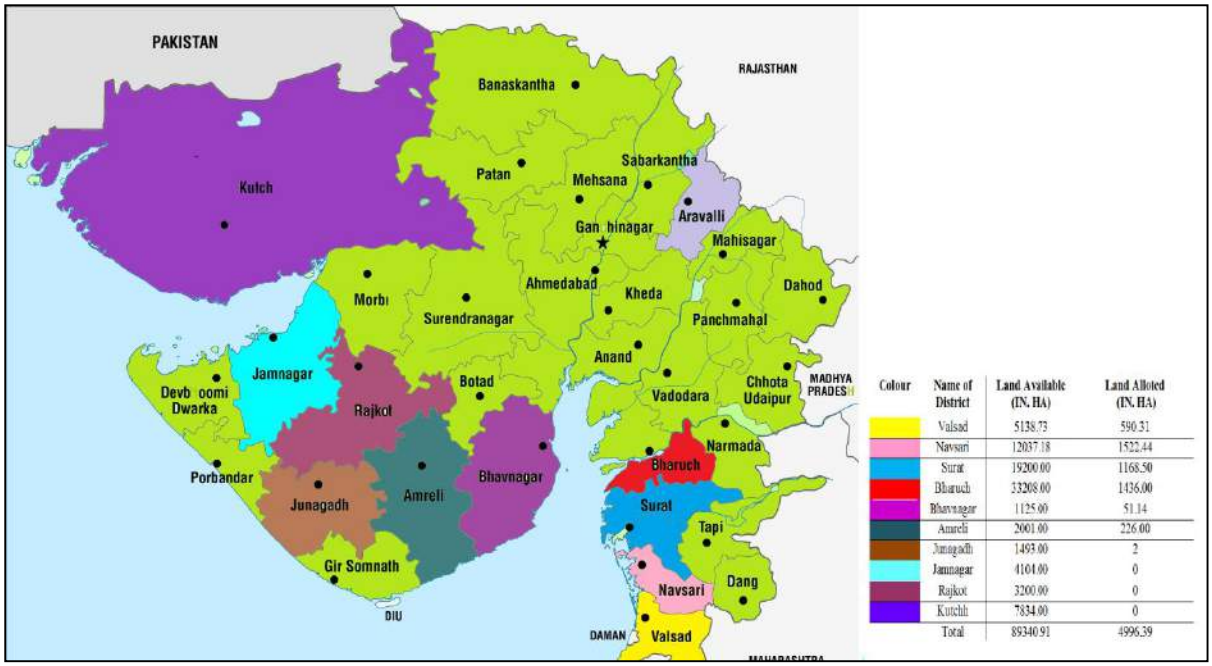
Indian overview



State Wise Available Brackish Water Area (Lakh hact.)
(Source: Handbook on Fisheries Statistics 2000. Govt of India)

Gujarat at glance

The state of Gujarat is blessed with largest coastline of India. These long stretches provide 1600 km coast, along with 0.21 lakh hector of estuarine and 3.76 lakh hector brackish water area with water rich in nutrients and marine life. Fisheries have a major role in social and economic development. Gujarat has been one of the leading producers of marine fish in the country. However, due to increasing demand of fish products there is tremendous pressure on fishing resources which resulted in a decrease in the catches of several highly valued resources. Hence there is an urgent need for diversifying the fishing industry of the state into other fishery-related activities to help sustain the industry and the employment generated by it. Gujarat stands relatively down in the order among Indian states, with regard to aquaculture.



Species Resources for Coastal Aquaculture

The State of Gujarat, having rich biodiversity, has exclusive strengths in marine resources. The longest coastline confers enviable richness in terms of species diversity with about 462 marine species of flora and 782 species of marine fauna, offer a vast potential base for research and development. Species available for aquaculture are Milk fish *Chanos chanos*, mullets *Mugil* spp., pearl spot *Etroplus suratensis, Lates calcarifer,* threadfins *Polynemus indicus* and *Eleutheronema tetradactylum*, Recently CMFRI achieves success in breeding and seed production of marine finfishes such as Grouper, Pampano, Cobia are also available for aquaculture practice. Shrimp farming as it is called in commercial parlance, has attained great importance in the recent years. Among these, *Penaeus indicus* and *Penaeus monodon* are the prize species, because of their fast growth, large size and high economic value. Other prawn species of importance for culture are *P. semisul-catus, P. mergulensis, Metapenaeus dobsoni, M. monoceros, M. affinis, M. brevicornis* and *Parapenaeopsis stylifera.* Besides the above spp. Culture of Tilapia spp. Is good option because of fast growing, prolific breeder, and an established in fresh as well as brackishwater areas.

Current practices

Shrimp farming in India was dominated by the black tiger shrimp, *Penaeus*

monodon until 2009. However commercial farming of other species was attempted but none could offer the level of returns on investments as that of the black tiger shrimp. But these export drastically dropped during 1990s due to proliferation of white spot syndrome virus-WSSV in the year 1994-95. The shrimp production of India in 2010 was 70,000 to 100,000. Farmers are really suffered due to low returns. Amidst the viral outbreak, shrimp producers began reviving production by various approaches, namely low stocking densities, judicious management practices with proper biosecurity, adoption of farmer club/associations, end user assurance, traceability etc. towards its sustainability. The tremendous production of American white leg shrimp in other Asian counties led to the introduction of *Litopenaeus vannamei,* in India on a trial basis in 2003, and through cohabitation studies made official in year 2009.

List Of Farms Registered in Various Districts of Gujarat

District	No of ponds
Bharuch	118
Valsad	105
Surat	328
Porbander	1
Amreli	11
Navsari	183

Shrimp farmers in India quickly diversified from black tiger shrimp to this exotic species. Currently in Gujarat majoriy of the farmers are taking the production of *Litopenaeus vannamei.*

Challenges

The coastal aquaculture sector faces a number of constraints despite its seemingly bright prospects and high potential for expansion and continued growth. There is also an urgent need to consider the practical foundation on which to establish a sustainable aquaculture sector to ensure sustainable development. Awareness of environmental responsibilities in the aquaculture industry is growing and farmers and investors are increasingly practicing improved management practices. The following issues face Gujarat fast growing aquaculture sector

- Technologies and farming systems
- Environmentally friendly technologies, which have benign impact on the community. Due
- consideration should be given in selection of farming system applied, i.e. traditional, extensive, semi-intensive, intensive, super intensive.

- Improved management practices and codes of good practice for aquaculture sector.
- Minimize the harmful effects of farm breed species to the ecosystem.
- Improved culture-based fisheries.

Species

Selection and improvement of species

- Feeding low on the food chain.
- Appropriate use of genetic resources and biotechnology.
- Careful introduction of exotic species.
- Diversification of animal and plant species for aquaculture.

Socio-economics

- Better awareness of responsible aquaculture concepts and practices.
- Mitigating the impact of industrial aquaculture in rural areas.
- Improving the contribution of small scale aquaculture to rural livelihoods.
- Defining property rights and access to resources.
- Mitigate conflicts among common

Fish seeds

- A consistent supply of high quality and healthy seeds.
- Deterioration of quality seed due to inbreeding, limited number of captive and wild breeders, lack of techniques in broodstock manipulation and poor hatchery technologies.

Feeds

- Improving the efficiency of food through good aquaculture feed manufacturing practice and feeding techniques.
- Cost effective feed.
- Research on the dietary nutrient requirement and feeding habits of cultured species.
- Culture of species that can utilize good farm made feed rather than require high quality protein rich feed.

Conclusion

There are considerable opportunities for further development in aquaculture, especially coastal aquaculture (mariculture) in Gujarat. Joint efforts of the government and the private sector would realize for the nation and people the huge aquaculture potential. To do so without the adverse side effects and impacts on the environment and social harmony, the government is taking measures to encourage, with appropriate incentives and assistance, the investors, farmers and other stakeholders to practice responsible production practices. It has, for instance, tasked the

Department of Fisheries with the responsibility of promoting the conservation of biodiversity and habitats and providing assistance to all forms of aquaculture.

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Aquaculture:
Cooperative and Cluster Farming

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A cooperative is a group of farmers who act together to achieve some common business objective' (Pomeroy, 2010)'. Cooperative production is generally seen as a means of improving small-holder capacity to improve product quality, as well as their bargaining power, capital investments and management skills (Coles and Mitchell, 2011). Two aspects of cooperatives are that they (a) are a legal, institutionalized device which permits group action that can compete within the framework of other types of business organization; and (b) are voluntary organizations set up to serve and benefit those who are going to use them.

Cooperative Farming

Cooperative farming means bringing together of all the land resources of the farmers in such an organized and united way that they will be collectively in a position to grow on every bit of land in cooperative farming members must buy a minimum amount of shares to join, have equal voting rights, and are offered services such as competitively priced inputs on credit and extension services. Cooperative farming a state policy was first suggested in 1944 by the advisory Board of Imperial council of Agriculture Research. The cooperative provides members with a number of important services, including credit for farm inputs, provision of technical advice, a computerized traceability system, increased market access through developing links with processors and buyers, and improved quality and safety of shrimp (through an internal control system). Cooperative farming where members must buy a minimum amount of shares to join, have equal voting rights, and

are offered services such as competitively priced inputs on credit and extension services. Unlike traditional cooperatives, however, profits will be distributed according to the proportion of members' shares rather than according to patronage (how much they use cooperative services) as with traditional cooperatives. However, as the cooperative has not yet earned any profits, this may change. Because of the way profits are distributed in traditional cooperatives, they often find it hard to increase the level of investment from members, as there is little incentive for members to invest more than the amount required. Cooperatives usually have a particular structure requiring many rules and regulations, making them less flexible than associations and increasing their internal administration costs. The cooperative has also increased members' access to good-quality inputs through negotiation of various partnerships and agreements with input suppliers and has improved the production and income of members.

Advantages and Difficulties of Cooperatives

There are a number of advantages of cooperatives including savings in marketing costs, more effective marketing, opportunities to exploit new markets, and opportunities to increase bargaining power. There are also a number of difficulties of cooperatives including developing joint responsibility, inefficient management, inadequate membership support and relations, lack of sufficient capital and credit, and relations with the general public. Cooperatives usually have a particular structure requiring many rules and regulations, making them less flexible than associations and increasing their internal administration costs.

Types of Cooperatives

As mentioned above, there are several different types of cooperative which may be applied to aquaculture depending upon the tasks performed:

1. ***Cooperative Association*** are those in which farmers producing a common product will form cooperatives to ensure widespread education about production techniques, about market developments, about legislative activities, and about other issues that affect their industry. The Wisconsin Aquaculture Association is an example.

2. Service cooperatives are those that provide their members with specific

business services (such as tax reporting or record keeping) or with services they could otherwise not obtain, such as credit and insurance.

3. Purchasing cooperatives are those through which members buy the inputs or supplies they need. By purchasing good together in bulk, members of purchasing (or supply) cooperatives can often secure volume discounts and thereby reduce costs of inputs for their individual members.

4. Marketing cooperatives are those through which members sell a large part or their entire product to the cooperative who markets the product on their behalf. They do not usually handle or process their members' raw product. A marketing cooperative serves to coordinate supply among many producers to meet larger buyers' demands for quantities and service, provide the economies of scale to break into new markets and establish high quality standards for all members to follow. By pooling their resources, producers can spread the costs of running effective promotions and hiring competent managers and sales people to market their products. The Noank Aquaculture Cooperative in Connecticut is an example of a marketing cooperative that markets clams and oysters for its members. The Nebraska Sand hills Yellow Perch Cooperative markets both yellow perch fingerlings and adult fish for fillet markets.

5. Farmer's bargaining groups are a type of marketing cooperative. While they do not actually process or market the product, they negotiate with processors or buyers on behalf of the cooperative members. The members of the bargaining group agree on a price and other marketing conditions they want and bargain with the buyer or buyers as a group.

6. Processing and Marketing Cooperatives These cooperatives transport, process, and markets members' raw products. This takes significant levels of capital. This capital can be acquired through equity drives of prospective members. This usually is enough to secure a loan for the remaining start-up expenses.

Steps in Starting an Aquaculture Cooperative

- Assessing the interest of potential members
- Selecting a steering committee
- Conducting a cost analysis of the business activity the proposed cooperative would undertake and a feasibility study to determine whether

there will be sufficient income to cover those costs

- Developing a business plan including specific objectives stating exactly what the cooperative aims to achieve year by year and a detailed capitalization strategy.
- Preparation of legal papers and hold first membership meeting. Electing officers and preparation of by-laws including such items as how profits will be divided, how much of production is to be sold to the cooperative, quality of product.

Cluster Farming

Cluster farming is defined as a group of min 20 small scale farmers whose shrimp ponds situated preferably in a same locality all ponds dependent on the same water source. Farmers were organized into self-help groups, originally called "aqua clubs" and now legally registered as farmer societies, which have joined to form "clusters" (groups of interdependent shrimp ponds situated in a specified geographical locality, typically comprising farmers who share resources or infrastructure such as water sources). The cluster concept was found to be a practical and effective way to communicate risks and risk management to farmers to reduce risks and maximize returns. All farmers are registered under CAA and also got cluster certification from MPEDA. The cluster farmers should elect their own governing board and prepare their rules and regulationsCluster farmers should maintain all records and documents for the traceability society accounts are audited by MPEDA. In some cases, the term "cluster" is synonymous with FO (i.e. a cluster or group of farmers),whichever way it is used, the term "cluster management" refers to a group of farmers or FOs that collectively implement certain production standards.

Cluster management has been used as a tool by NACA to facilitate the implementation of BMPs for small-scale aquaculture development in a number of countries in Asia (i.e. India, Indonesia, Sri Lanka and Viet Nam) and successful mechanism to empower small-scale rural farmers and to improve aquaculture practices, including those related to health management for the safe movement of live aquatic animals. Cluster management is thus used to enable self-regulation for the implementation of standards at the farm and processing level to ensure responsible

and high-quality aquaculture farming in a specific locality. Cluster management can provide mechanisms to introduce standardized, shared and improved methods for aquatic animal health management, including diagnostics, disease control and reporting. In India, NaCSA is facilitating the development of farmer societies made up of between 20 and 75 shrimp farmers to implement BMPs in order to reduce disease risk and increase productivity of shrimp ponds. Cluster management thus seeks to achieve responsible aquaculture production by encouraging farmers to adhere to codes of practice or BMPs as a group and to monitor each other's activities to ensure that the group complies with the principles of the particular scheme. Through cluster management, small-scale aquaculture farmers have increased chances of achieving priority market access, improved reliability of production and reduced risks such as disease.

The establishment of FOs can be a key element in enabling effective cluster management and maximizing benefits. For example, in the case of NaCSA's farmer societies in India (so far the best and most widely documented example of successful implementation of the cluster management concept), it is the farmer societies that are registered with the government and not the clusters. The clusters are an informal, unregistered grouping of societies used to enable the specific function of self-regulation and quality management within a specific location. As such all the farmers located within a cluster are not necessarily members of farmer societies, which can present problems when it comes to cluster management.

Cluster Certification

- Narurland cluster certification for organic scampi
- NACA-NAcSA developing "Cluster certification Guidelines".
- NAcSA is working with Fair trade Foundation to take up pilot testing of "Fair trade standards for small scale shrimp farmer societies" in India.
- Independent certifiers showing interest in societies for cluster certification.

Advantages of Cluster farming

- Enhancing their incomes and bargaining power in markets
- Clusters improve information exchange and sharing of experience among participants

- Farming skills and technical knowledge
- Access to financial services and ability to manage funds
- Knowledge and tools to use information on markets, services, technologies, and rights
- Self respect, social esteem, and relationships to authorities and other social factors

Conclusion

Cooperative farming and Cluster farming is to enable aquaculture farmers to adopt sustainable and environment friendly farming practices to produce quality and safe aquatic products such as shrimps, scampi and fish for export and domestic markets. These are the new concepts arises for the development of Aquaculture, so there is a need to implement it properly.

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An Introduction to Underwater Video Technique: Scope, Constraints and Future Prospects

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Aquaculture, the farming of aquatic animals and plants has turned out to be an important industry worldwide. It occupies a very important place in the socio economic development of the country. As a major source of export and foreign exchange earning in many developing countries, it has been recognized as a powerful income and employment entity. Successful fish culture is based on authentic breeding and feeding performance protocol. Growth and survival rates may not be sufficient to understand reasons for differences in breeding and feeding success and thus the reason of demand and supply gap. Performance based on trial and error may not provide a successful production protocols for each species. There is strong need to understand the behaviour of each species which help us to understand the condition of organism in well manner instead of trial and error of current scenario. Behaviour is the manifestation of an organism's response to both internal (physiological) and external (environmental) signals. Restriction of visibility under water makes this task more difficult but with the development of digital imaging techniques over the last decade, there are now new opportunities to study complex behavioural patterns in fish. The tracking of moving objects and the monitoring of their activities by image sequences obtained from video cameras. It is an automatized procedure that determines animal position over time and gives the resulting tracks with a large array of data such as distance travelled, speed or space used. Video multitracking, enable us to understand more than one individual tracking simultaneously. Specifically, in situations where a large number of individuals are involved, the use of video-tracking data is essential, as manual analyses would be complicated, time-consuming and sometimes even impossible. Today, multitracking allows

us to observe directly the behaviours of groups and to determine the real interaction rules by sampling data collected in nature or in the laboratory, without any a previous record (Ballerini *et al*.2008; Katz *et al*.2011). The basic set-up of a video-tracking system consists in filming organisms, such as fish in an aquarium, with a video camera. The signal from the camera is then either transformed into a numerical video file through a frame grabber linking the camera to a computer or is directly available if the camera is digital. The signal can be processed in real time by video-tracking software.

History and importance of video techniques

The first published work reporting the use of underwater video systems in the coastal environment dates back to the 1950s.The Scottish Marine Biological Association of Millport developed an underwater video program in 1948, and tested it in the Aquarium of the Zoological Society of London in 1949 (Barnes, 1952, 1953). In 1951, the Royal Navy constructed a system which was successfully used to identify a Royal Navy submarine lost at sea in 1951. It then served for other projects on bottom fauna (Barnes, 1955) as suspended in a mid-water environment (Backus and Barnes, 1957) and for other Navy applications (Barnes, 1963). RUV has used more frequently in marine sciences since the 1960s .It provided the first data on fish movement and behaviour in daytime and at night, which had not been previously studied without human disturbance (Barnes, 1952; Kumpf and Lowenstein, 1962).Under water video techniques help us to understand animal behaviour and there activity, spatial and temporal pattern of fish abundance, assessment of species respond to environmental condition, habitat mapping, human disturbance effect on fish species, breeding and feeding respond toward any exogenous sources or disturbances. Through video techniques, one can stored data first and analysed later, which is safer as this avoids a system crash or experimenter errors of calibration video tracking consists in recognizing and following spatially over time moving objects or organisms on the basis of typical features, which could be body shape, body colour or body greyscale level and which are visible in each frame of a video sequence (Delcourt *et al.*2013).

Direct observation v/s video techniques

Under direct observation it's very difficult to examine fast events (fish attack,

plankton escape) Based on the subjectivity of the observer it's difficult to compare with other studies and to quantify certain aspects of the behaviour: like speed, path complexity etc while in video recordings and video analyses Fast events can be examined easily,videos can be reanalyzed later in this more behavioural aspects can be quantified which is difficult or even impossible in direct observation.

Types and assembly (fig)

I. Remote Underwater Video (RUV)
   a. Linked systems
   b. Autonomous systems
II. Baited Remote Underwater Video (BRUV)
   a. Horizontally oriented BRUV
   b. Vertically oriented BRUV
III. TOWed Video (TOWV)
   a. Seabed TOWV
   b. Mid-water-TOWV
IV. Diver-Operated Video (DOV)
V. Stereo-video technique

RUV systems exhibit different designs and technical features, including additional sensors, and can be distinguished in terms of their autonomy (linked or autonomous). Linked systems the system developed by LaFond et al. (1961) filmed from the surface to the bottom (20 m depth) while moving up and down a vertical-rail track, It is used to study diurnal and nocturnal fish movements along with plankton dispersion and lights. The latest linked systems are permanent observatories using cables for energy supply, data transfer and instrument control (Aguzzi et al., 2012). Autonomous system Fedra and Machan (1979) used the first autonomous RUV in the North Adriatic Sea (Mediterranean) in order to study the behaviour and distribution of benthic and demersal species, their feeding activities and movement patterns, along with species interactions and the influence of environmental conditions.

Baited Remote Underwater Video (BRUV)

A BRUV system uses either a single camera or two cameras filming the area surrounding a bait used to attract fish. The bait bag is placed close to the camera, at a distance ranging between 0.5 m and 1.5 m (Ellis and DeMartini, 1995; Willisand Babcock, 2000; Heagney et al., 2007). BRUV systems are directly deployed from the boat (Watson et al., 2005, Cappo et al., 2007a, Bassett and Montgomery, 2011). The main differences among BRUV systems concern the orientation of the system in relation to the sea bottom (horizontal or vertical), which result in distinct observed abundances

and species compositions (Langlois et al., 2006; Wraith, 2007). BRUV has also been used with infrared light to study nocturnal fish.

Horizontally oriented BRUV

Horizontal BRUV (H-BRUV) systems have been mainly used to study spatio-temporal variations in reef fish assemblages, the influence of depth and location upon fish and species distribution, and the effect of MPAs on biodiversity (Cappo et al., 2007b and section 3). H-BRUVs are generally set on the seafloor, though Heagney et al.(2007) used mid-water BRUV to study pelagic fish.

Vertically oriented BRUV **(V-BRUV)** has been used for studying the size and abundance of carnivorous fish (Babcock et al., 1999; Willis and Babcock, 2000) and the effect of protection by MPAs (Willis et al., 2000, 2003; Denny and Babcock, 2004; Denny et al., 2004; Willis and Millar, 20 05). The restricted field of vision due to the camera pointing downwards ensures a constant field of view and a constant focal length, particularly where water clarity or topography varies between observations.

TOWed Video (TOWV)

Machan and Fedra (1975) introduced the first TOWed Video technique (TOWV) in shallow waters. The system was towed by a vessel at low speed (0.1 to 1 m s^{-1}). TOWV films along transect of predefined size and trajectory (30 m to 20 km). The various systems developed, were linked to the vessel by a coaxial cable and a rope. The main difference among them lies in the position at which the system operates in the water column, i.e. seabed or mid-water.

Seabed TOWV

In the coastal domain, the first TOWV systems were towed on the seabed using a sledge. The video camera is slightly angled downwards on the sledge, which carries additional equipment. Seabed-TOWVs have been used to study sea floor and epifaunal species (mostly crustaceans and flat fish). It should be noted that in shallow waters such as lagoon areas, vagile species were found to be sensitive to the boat noise

Mid-water-TOWV

Mid-water-TOWV systems are more recent than seabed-TOWVs in shallow waters (Norris et al., 1997). These systems are towed at a constant elevation in the water column, thus providing a wider view of the seafloor compared to seabed-TOWVs. The system of Riegl et al. (2001) is set on each side of the boat with vertical tubes that can be lowered or raised between 0.5 and 3.5 m below the sea surface, so as to adjust to varying

depth .They have mostly been used to characterize, quantify and assess changes in benthic flora (seagrass, macro-algae and coral) and fauna.

Diver-Operated Video (DOV)

The diver-operated video technique (DOV) consists of a diver holding a video system and filming a defined area. Observation area may vary in size (transects from 2 to 500 m,) DOV has been used to record benthic habitat along long transects (up to 500 m long).The DOV technique (Alevizon and Brooks, 1975) involves a diver filming vertically along a transect line. DOV is generally conducted at a constant swimming speed over the entire transect (0.1 to 3 m s^{-1}).

Stereo-video technique

The stereo-video technique is not additional to those described above, but it involves a particular recording that produces a 3-dimensional (3D) image. It was developed by Harvey and Shortis (1995) to improve fish size estimation by divers. The technique simultaneously uses two cameras to record the same scene. Left and right images are synchronized on the computer based on a light-emitting diode (LED) placed at 2.5 m from the cameras and seen on both images. Images are then cross-checked from ad hoc software to obtain a 3D image allowing individual size measurement. A 1.4 m distance between the two cameras was found to provide a trade-off between the precision afforded by a greater distance and diver's ability to manoeuvre the system (Harvey and Shortis, 1995). This system recorded and measured individuals in a distance range of 2 to 10 m, depending on underwater visibility Stereo video has been shown to provide more accurate estimates of both fish length and distance than visual estimation by divers (Harvey et al., 2001a, 2001b, 2002a, 2004) or single video (Harvey et al., 2002b). As such, it also helps distinguishing individuals (Harvey et al., 2003, 2007) Several comparisons of underwater observation techniques used stereo-video (Watson et al., 2005, 2010; Langlois et al., 2010). Shortis et al. (2009) provide a detailed review of the status of underwater stereo-video measurement and marine and ecology applications. With the same objective of measuring fish, Heppell et al. (2012) used two lasers fixed on each side of a single camera, rather than stereo-video.

Future prospects

Human operated systems will continue to be used, particularly for research. But there is a wide scope for automated systems. These can be permanent stations

with multiple sensors, either cabled or mobile systems transmitting information, e.g. programmed gliders (Moline and Schofield, 2009).Such advances will considerably increase the amount of data collected by underwater video systems. Several projects have been set up, example Fish4Knowledge project, which aims to analyse undersea fish videos (www.Fish4Knowledge.eu, Phoenix et al., 2013). Properly managed data is the second issue, particularly in view of long-term monitoring. Furthermore, data for biodiversity monitoring and assessment are often collected at the scale of an entire ecosystem, and they are to be shared within collaborative projects. Global commitments to conservation also entail research issues at larger scales, particularly regarding spatial patterns of biodiversity and ecosystem approaches to management and conservation (Christensen et al., 1996). Hence, for both research and monitoring purposes, observations with improved spatial coverage and resolution should be carried out in all habitats; they should document exploited and non-exploited species, as well as benthic coverage, including sensitive taxa such as sea grass and coral. These considerable information needs cannot be achieved solely through the techniques used so far, and complementary observation techniques are needed, among which video techniques, either on stand-alone basis or preferably combined with other techniques, are definitely a good idea.

Scopes and constrains

Video multitracking can make important contribution to the applied sciences. Firstly it can be used to test potential drugs or pollutants at the social level. Second it will be useful for characterize the parameters controlling social behaviours and by monitoring the social behaviours one could study quantitatively the well-being of social species, notably in the laboratory, and in fish farms, finally challenge would be leaving the laboratory to track fish and other animal individually in nature.

Conclusion

Video multracking is one of the techniques which can provide huge scope to understand the physiology and behaviour of the organism in an efficient manner. Which is utmost important for development of perfect protocols of feeding and breeding of any culture able species. Apart of that, this technique brings us very close to the nature and it will be easy for the researcher to work according to the nature law.

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Wular Lake: Threats and Conservation

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The Wular Lake is the largest fresh water Lake in India. It is located in Bandipore district of Jammu and Kashmir state. It is also one of the largest freshwater Lake in Asia. It lies between 34º 20' N latitude and 74º 36' E longitude with an elevation of 5,180 meters above Sea level. The Lake basin was formed as a result of tectonic activity and is fed by the Jhelum River. The outline of the Lake is very irregular. But it has somehow elliptical resemblance in shape. Mountainous ranges surround the Lake on the North-eastern and the North-western sides which drain their run-off in the Lake through various nallahs. From South, the Lake is the ''Delta of the Jhelum'' into which the river empties itself before seeking a passage, out of the Lake, to Baramulla. It is merging with the Wular Lake at Banyari (Hajin) and leaving the Wular at Ningli (Sopore).

Location

The Wular Lake is located about 39 kms. North-West of Srinagar city and at the periphery of the Lake is the tehsil limits of Sopore, Bandipore and Sonawari. It can be approached from Srinagar city by road via Srinagar-Bandipore and Srinagar-Sopore highways and via waterway through course of the River Jhelum.

Dimension

The dimension of the Lake have been roughly estimated, the maximum length, breadth and depth of the Lake are 16 kms. 7.6 kms. and 5-6mts respectively. The circumference of the Lake covers 30 miles.

Area

Earlier Area

According to the authentic historical record the area of the Wular Lake was 189 sq. kms. But during floods the area swelled upto 273 sq.kms. (*Kalhan's Rajtarangni*) and the records of 1961 reveal that the area of the Lake was about 202 sq.kms.

Present Area

The present area of the Lake as per the revenue records has been put as 130.25 sq.kms. out of which 3.70 sq.kms. is under agricultural use, 0.15 sq.kms. under human habitation and 60.50 sq.kms. under agro-forestry and remaining the net water spread area (water body) of the Lake as 65.90 sq.kms. But during floods the water-spread area extends and the Lake acts as a large absorption basin, as all the rivers and streams ultimately pour into it. The highest flood level of the Lake has been recorded at 1579 mts. So, some have mentioned the area of the Lake as 72 sq.kms. The area for Wular Lake has been adopted as 65 sq.kms. The area of the Lake fluctuates with the change of season in a year. It shrinks and swells in different seasons of a year. The area calculated on the basis of satellite imagery is shown in table 1.

Table 1: Area of Wular Lake (Source:- Department of Fisheries J& K, 2011)

Season	Area in sq.kms.
Spring	132.5
Summer	124.5
Autumn	56.5

Catchment Area

The Wular Lake commands a huge catchment area of 83000 hectares. However, the latest survey, conducted through remote sensing in 1997, puts the present total area of the Lake as 79 sq.kms. of this, 44 sq.kms. is clear water body and the rest either marshy or covered by willow *(Salix alba)* plantation.

Tributaries/ Water Source

A number of various tributaries whether perennial or seasonal, whether in flowing or out-flowing and whether spring-fed or snow-fed find their easy access in to the Wular Lake. The Lake is fed-by the innumerable breeding canals. The following are the main streams/rivers of the Wular Lake, as:-

I. *River Jhelum.*
II. *Ashtangoo stream.*

III. Erin stream
IV. Kanihama stream
V. Madhumati stream
VI. Putushai stream.
VII. Gundar stream.
VIII. Ferozepur stream.
IX. Sukhnag stream.
X. Gad-kul stream.
XI. Argam stream.
XII. Ningli stream.
XIII. Butengoo stream.
XIV. Ajas stream.
XV. Haritar stream.

Economic Significance of Wular Lake

The Wular Lake carries importance for many economic reasons, its picturesque beauty helping tourism as tourists from length and breadth of the country as well as from other countries visit here to enjoy nature. The Lake provides bread to a considerable portion of its population. The chief community that is fishermen who live along its periphery or elsewhere earning their livelihood by carryout fishing operations here. Wular Lake is an important fish habitat, the main exotic species of Common carp are *Cyprinus carpio var. nudus* Leather carp (Punjab Gad), *Cyprinus carpio var. Communis* Scale carp (Punjab Gad), *Cyprinus carpio var. Specularis* Mirror carp (Punjab Gad) and the main endemic species of Snow trout are *Schizothorax esocinus (Chhurru), Schizothorax plagiostomus (Khont), Schizothorax labiatus (Chush), Schizothorax richardsonii (Khel), Schizothorax niger (Ale gad) and Schizothorax curvifrons (Satter gad).*

Fish from Wular Lake make up a significant part of the diet for many thousands of people living on its shores and elsewhere in the Kashmir valley. More than eight thousand fishermen earn their livelihood from the Lake, primarily fishing for the endemic *Schizothorax* species and the non-native carp. Among the carp it shares about 70 percent of the total fish production of the Wular Lake and Native species shares about 30 percent. Hundreds of other local villagers are employed by cooperative societies that trade the fish catch. Similarly, its aquatic weeds are used as fodder for cattle, *trapa* (water-nut) is used as an edible food item, *nelumbium* (lotus-root) is used as a vegetable and *thypa* used as fibre for hand-woven mats, are the major gifts of the Wular Lake bestowed by nature. These have good economic

value and sustain the livelihood of thousands of local inhabitants. Besides, navigation (transportation) of goods and people has long been associated with the Lake. The Lake provides cheap mode of ferrying from one area to the other. The Lake also possesses importance by way of irrigating paddy fields lying in its catchments thus, enhance agricultural produce to manifolds.

Table 2: Fish production of Wular Lake Jammu and Kashmir (Source:

Department of Fisheries, Govt. of J & K, 2011)

Year	Fish production (in Kg)
208-2009	38,86,500
2009-2010	36,65,400
2010-2011	37,00000
2011-2012 (February)	35,30,000

Threats and Preventive Measures

The Wular Lake, despite being one of the largest fresh water Lake of Asia, is under serious decline of the fish and fisheries resources. The factors responsible for the decline of the fish and fisheries resources and the preventive measures suggested to save the Lake from further degradation through the findings are discussed as follows:-

1. Climatic Conditions

Consequent upon the prevailing dry-spell since few consecutive years, the Lake faces very low water level and dimensions have shrunken beyond expectations. Deforestation is the root-cause of low precipitation that is change of climate that has happened due to merciless cutting of trees since one and a half past decades. It has an adverse impact upon the flora and fauna i.e. aquatic-biota of the Lake including fish species. The fish species of the Lake migrate as a result of dry-spell to the river Jhelum and other tributaries of the Wular Lake. The inhabitants around the Lake have converted hundreds of kanals of the Lake area into cultivable land. Therefore, it is need of the hour immediate ban should be imposed on all types of deforestation even excessive grazing and browsing of the cattle and large scale afforestation measures are needed badly in the catchment area.

2. Encroachment

People residing around the Lake have encroached upon the periphery and

shallow portions of the Lake and have converted these portions into dry land for cultivation and construction purposes. In this way, they have ruined breeding grounds of the fishes especially *schizothorax spp.* of the Lake. Besides this, the Government agencies like Social Forestry, Rukhs & Farms, and Revenue have also utilised the dried-up portions for plantation and such unplanned practices have even augmented the deterioration pace of the Lake. Therefore, it is necessary that the illegal settlers and cultivators clear the plantation with proper planning and dried areas may be annexed back to the Lake after necessary dredging. As such, it is inevitable to restore the original area of the Lake which can be possible by proper demarcation and constitution of an authority empowered to execute the plan for restoration of original area of the Lake followed by dislodging and rehabilitation of such population.

3. Plantation

Consequent upon the prevailing dry-spell, a large dried area of the Lake is under dense plantation from all directions. The programme has been undertaken by the social forestry, World Bank grant-in-aid agency. The plantation is spread over hundreds of kanals of the Lake area where poplars, willows and paddy-fields thrive, at present. Since, plants have ability to carry water different parts through root system and much of it transpire through stomata of the leaves in the form of vapours in atmosphere. Hence, plants have considerable role in reducing water level of the Lake.

Therefore, plantation in the Lake area should be totally banned and such acts would be treated with stern action through judiciary.

4. Erosion

Extensive deforestation cause the soil erosion in the denuded catchment area of the Lake that degrade water quality and makes its water turbid which restricts penetration of sun-light, as a result paucity of phytoplankton production i.e. less productivity of the Lake takes place. Water at some peripheral portions of the Lake is blackish in colour due to mingle mud. Permanent turbidity causes clogs of gills in fish and sometimes mortality of fish. Further, it has an adverse impact upon proper growth and health of various fish species.

In order to check the soil erosion aforestation in the catchment area is must, besides imposing complete ban on deforestation in the catchment area.

5. Deposition

Sewerage and drainage of the entire valley exclude Lolab and below Sopore Town, directly or indirectly find its easy access into the Wular Lake and during floods Lake acts as a absorbing basin. Moreover, the River Jhelum and other tributaries of the Lake brought silt and clay especially during floods into the Wular Lake those accumulate in the benthic zone. Thus, continuous entry of clay, silt and sand takes place. Deposition of siltation and sedimentation reduce water retention capacity and also the depth of the Lake. It is estimated that annually sediment deposit ranges from 50,000 to 1,70,000 cm per 100 sq.kms. the siltation reaches its peak during floods.

Excessive thypa (nur/pachh) production has also contributed to the decrease in the depth of the Lake. Since, *thypa* plant has property to hold soil (deposition) by its nodules that hardens the bottom of the Lake and cast a serious impact on the Lake.

Therefore, sedimentation tanks should be established at the entry points of various streams and rivers in order to check the inflow of heavy silt load that find their way into the Lake. Further, total extraction of the thypa plant and its cultivation should be check upon, so that the Lake would be saved from further deterioration.

6. Weed Infestation

The Lake is infested with abundance of aquatic weeds. The carpets of *Salvinia* and *Nymphoides* act as an impediment to sunlight and reduce the penetration of light to a greater extent. It is mere result of it that blanketing-effect by macrophytes has occured i.e. weeds don't allow sunlight to enter various substrates of the Lake at the water surface, which in turn, determines, the paucity of phytoplankton production. The less phytoplankton production means scarcity of food and depletion of Dissolved-Oxygen content in the Lake for diverse fish species. This condition will lead fishes to migrate to the River Jhelum and other feeding canals of the Lake. Subsequently, *Schizohtorax* species of the Lake, which once had been the major portion of the daily-catch, has dwindled to a greater extent,

at present. Moreover, the migration of fishes towards the breeding grounds is necessary during the spawning season and aquatic weeds cease them to accomplish the natural phenomena i.e. breeding. Besides this, excessive growth of weeds in and around the Lake has contributed towards enormous loss of water volume. Therefore, the deweeding either manually or by installing a deweeder machine is required on priority basis.

7. Insect Growth

Owing to an alarming increase of insect population in the aquatic weeds over the years of dry- spell, the eggs of the fish are eaten-up by aquatic insects in the juvenile stage. An adult of Common carp remains usually in deep waters and during spawning period migrates to the shallow weed infested areas for spawning purpose. The ova of the carp are adhesive and remain submerged with weeds in nature. These insects feed upon the fertilized ova. The uncontrolled growth of aquatic insects results mass killing of juvenile carp. Therefore, for the development of the Lake and the fisheries, proper insect control through proper measures of biological remedy is essential for the fish growth.

8. Indiscriminate Fishing

According to the fisheries legislature catching of undersized fish i.e. below 5 inch is strictly prohibited under act 7Fa. The fishermen of the Wular Lake catch whatsoever fish that get trapted in their nets even the undersized. The fishermen of the Wular Lake are not so witty and prudent to throw back their undersized catch into the Lake till to attain proper growth of table size. This has considerably decreased the fish population of the Lake. Therefore, the deployed staff of the Fisheries Department at the Wular Lake should enact the Fisheries regulation in true sense. Further, the gears allowed under J&K Fisheries Acts are only gears permitted to tackle fish. Besides these, all other types of gears like *Panzri, gill-nets* (also called fixed engine) are considered as illegal gears, as their mention does not lie in the legal gears. These are the common gears that poachers of the Wular Lake use. Their application is an aggression upon the livelihood of common fishermen whose sole source of income is fishing. If anti-poaching drive is not activated, perhaps,

capture fisheries would be no more after a decade or two in the Lake. Moreover, fishing methods like sprinkling of paddy, bleaching powder, use of explosive devices, application of electrical shocks in the water at pools where usually shoals of fish are present, are treated as offences. And for such offences, offender has to either pay compensation or face trial i.e. court challan.

9. Pollution

Almost all kinds of water pollutants find their way to the Wular Lake. Fertilizers, insecticides, pesticides and weedicides are washed-away from the agro-land by the rainwater to the Lake. Besides, domestic of every type of household wastes, flow of excreta and fecal matter through sewage drains, pathogens (virus, bacteria, germs and parasites) and chemical effluents (soaps and detergents) have contaminated the clean water of the Wular Lake. The fertilizers and pesticides used in the paddy fields and orchards in the catchments run-off easily into the Lake. This has augmented weed infestation around the Lake and causes hazardous impact upon the fish fauna of the Lake. So, such pollutants on one hand decrease the fish population and in the other hand render the existing fish unfit for human health because of bio-magnification and disease causing organisms. The water condition does not favour proper growth, good nourishment and survival of the fishes. The water which was once utilized for domestic purposes like cooking, drinking, washing and bathing have now degrade by way of quality of taste, colour odour and the presence of harmful organisms. Pollution adversely affects the range of physico-chemical parameters like temperature, pH, DO_2, CO_2, alkalinity etc. Pollution cause DO_2 depletion and, however, part of DO_2 gained by diffusion of waves and currents of air. This will lead fishes to migrate to nearby streams and rivers in order to feel safer from this persecution for favorable safe and sound survival. Hence, dearth of fish fauna would occur in the Lake. Besides this, permanent DO_2 depletion in water reduces immunity of fish species and fishes become victims of some bacterial and fungal diseases. Further more, corpses of dead cattle are being thrown in the Lake that degrade water quality by way of producing noxious gases ($-NH_3$) after

decomposition and thus enhance water pollution. Therefore, sewage treatment plants (STPs) should be established for removal of toxic effluents and pollutant treatment in order to maintain graded quality of water for the Lake.

Conservation of Wular Lake

In order to save the Lake from further deterioration and restore the pristine glory of the Lake, several conservative measures are to be adopted for the development of the fish and fisheries resources of the Wular Lake:-

1. Fish-Seed Stocking:-

The Lake is needed to be stocked with quality fish seed of fast growing fish species, and fisheries staff has to check-upon undersized catching of fish i.e. below 5''. So that the development of the Lake by way of the fish and fisheries take place itself and economic condition of the fishermen community better off.

2. Watch-N-Ward:-

There should be strict watch-n-ward by the departmental authorities in order to curb illegal fishing. The fisheries staff deployed in the Lake has to check-upon:-

(a) Possession of fishing licence

(b) Mesh-size, catch-size and timing of fishing.

(c) Apply of gears like *Panzri, Gill-net etc*.

(d) Indiscriminate fishing by sprinkle of paddy, use of bleaching powder, explosive devices, electric shocks etc.

(e) Fishing during closed season i.e. spawning period in the breeding grounds of the Lake

(f) Encroachment along the banks

(g) Protection of reserved, protected waters and sanctuaries

3. Deweeding

The Lake should be deweeded by way of manual practice instead of installing a sophisticated deweeder machine in the Lake. Deweeding by means of manual practice provides employment to the youth of the fishermen-community; rather deweeding by a deweeder machine is not an effective way, as roots of the weeds remain at their places in the Lake. Besides, practically it is seen that weeds grow more in quantity than before deweeding position.

4. Raising of Bunds

The low-lying areas existing in the periphery of the Wular Lake i.e. vast areas of tehsil Sonawari inundate during

annual floods. Floods causing loss of property and deposition of soil in natural beds and dimensions at the end. In order to save the Lake from ruination and the inhabitants of flood prone areas from widespread damage to property i.e. damage of agriculture (paddy-fields) as rising of bunds towards low lying areas is necessary.

5 Construction of Barrage

The Government in Kashmir had planned the *Tulbul Navigational Lock Project* in the Wular Lake at the exit, so as to retention capacity increase and the shallow areas around the Lake exposed to sun would be covered under water, besides production of hydroelectricity. However, the project did not take-off in the face of stiff resistance by Pakistan which considers it against the *Indus Waters Treaty* signed between India and Pakistan at Karachi on September 19, 1960.

Moreover, dams act as a physical barrier to migration, pending to prevent access of the fish to their usual breeding, rearing and feeding grounds. The denial of migration may result in permanent and irrevocable reduction of fish stocks from lowering the levels of abundance to complete extermination the niche so created.

6. Dredging

The Lake requires dredging at the dried-up areas and for removal of siltation and sedimentation at the bottom to deepen the Lake. Besides, the River Jhelum and other feeding canals of the Lake can be cleaned by dredging process. The dredging is inevitable to reinstatement and maintenance of the original existing water body. The dredging can also rejuvenate fish and fisheries resources of the Lake.

Conclusion

A few suggestions are given for the conservation, protection, development and management of the Lake are:-

1. Demarcation of the Lake in par with the revenue record of 1947.
2. Removal of encroachments on the periphery of the Lake.
3. Heavy plantation limits the living space of fish, upsets the physico-chemical qualities of water, checks oxygen circulation, creates depletion of oxygen, promotes accumulation of deposits of siltation, obstructs netting operation, stops penetration of sunlight. Heavy load of thousands of

tons of willow leaves in Autumn pollutes the water to large extent producing foul smell causing serious menace to fish particularly to Schizothorax species. Besides, has reduced the clear water area of the Lake to a mere 44 sq.kms. the willow tree absorbs about 7 ltrs. of water per day thus causing water shortage in the Lake.

4. Complete displacement of all the housing colonies inside the Lake. Ban should be imposed on the construction of houses in the Lake area.
5. Control on quarrying sites as large quantity of clay flows from them into the Lake. Quarrying should be properly regulated.
6. Proper disposal of household/municipal wastes into the Lake through many canals. About 14 small seasonal/perinnial canals are being used for the disposal of municipal and household wastes mainly used ''ploythene bags'' into the Lake. Small filtration/ treatment plants should be installed to check the flow of these wastes into the Lake.
7. Dredging of islands on scientific lines which have been formed due to heavy siltation at the mouth of the Erin nallah below Lankreshpora near Yarbal colony.
8. Environmental awareness campaign with the participation of the common man should be organized for the conservation and the protection of the Lake. In order to restore the past glory of the Lake, to reclaim its original water area. It is necessary to take up the development of the Lake for tourism, fisheries, generation of employment/revenue on war footing basis. Task force should be created to monitor various activities in the Lake for conservation of the Lake. Developmental steps may kindly be taken up immediately to stop the speedy deterioration of the Lake.

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Anoestrus in Indigenous Cattle and Buffalo

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Cattle and buffaloes become infertile when they are neither fertile nor completely sterile and are delayed or irregular for production of annual live calf. Although causes of infertility are many and may be complex, anestrous and repeat breeding have been identified as the main factors responsible for this malady. It was reported that 10 to 30 % of lactation yield may be affected by infertility and reproductive disorders and 3 to 6 % of the herd is culled every year in developed countries for these reasons. Although authentic information regarding the economic losses of infertility under Indian condition is not readily available, the extent of the problem is likely to be greater in tropical countries. As per the reports of ICAR (2002) 18 – 40 % cattle are culled every year in India due to infertility or sterility Anestrous, repeat breeding, cystic ovarian degeneration, uterine and tubal disorders have been observed as the most common gynaecological problems in cattle and buffaloes in India. Anestrus is one of the most commonly occurring reproductive problems in cattle and buffalo in India, affecting livestock productivity and economics to a great extent. The problem is more severe in sub urban and rural areas of the country. It is a functional disorder of the reproductive cycle which is characterized by absence of overt signs of estrus manifested either due to lack of expression of estrus or failure of its detection. Anestrus is observed in post pubertal heifers, during pregnancy, lactation and in early postpartum period in adult animals. In heifers, it poses a herd problem possibly due to low plane of nutrition, stress of seasonal transition or extremes of climatic conditions. Expression of overt signs of estrus is greatly affected by heat stress in buffaloes. Modern feeding and managemental practices also accentuate the problem in commercial dairy farms. Incidence of anestrus though varies in the different managemental system but it is more in

buffalo than the cattle, and especially during summer

Incidence

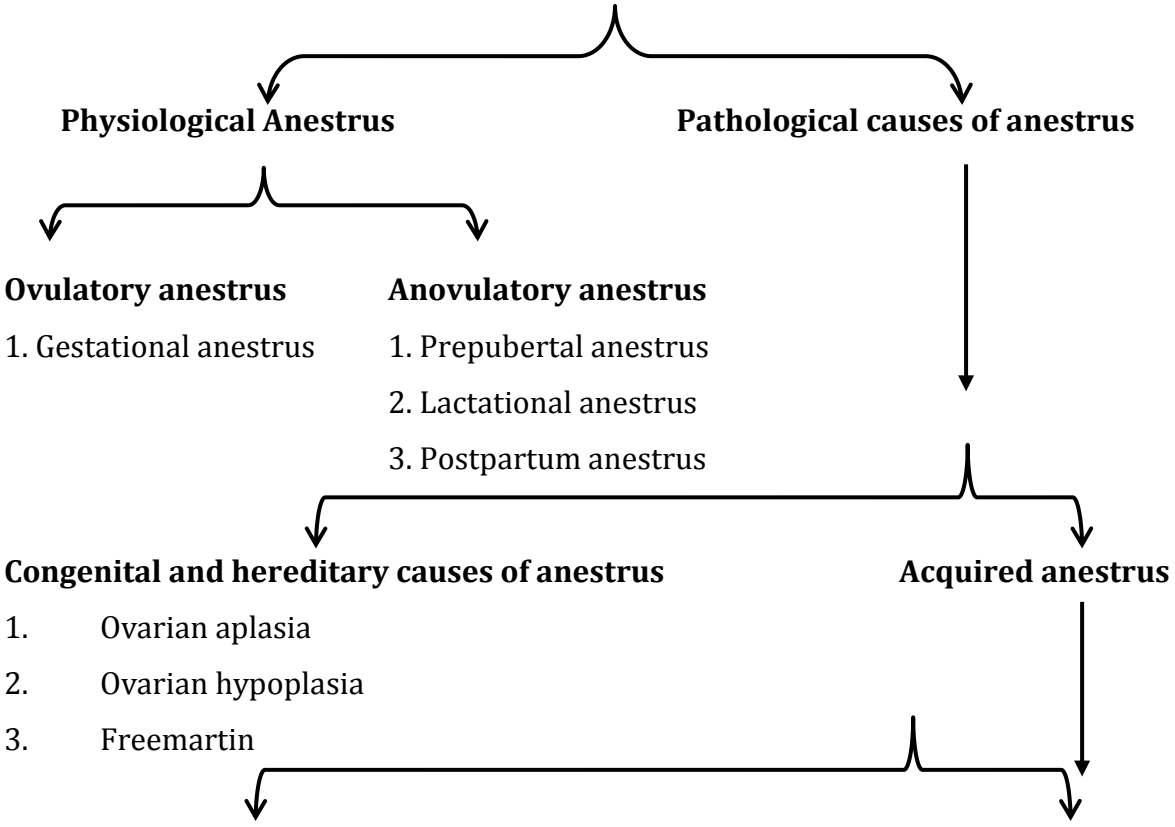
A large variation on incidence of anestrus has been reported in literatures depending upon species, breed, parity, season, level of nutrition, managemental conditions, geographic environment The period of postpartum anoestrus is usually longer in buffalo than the cattle under similar management conditions (Jainudeen and Hafez, 1993). In comparison to cows, buffaloes have lesser number of preantral and antral follicles, smaller sized pre– ovulatory follicle and greater tendency of follicular atresia which might be responsible for high incidence of anestrus in buffaloes.

Classification of Anestrus

Based on ovarian activity, anestrus cow has broadly been classified into ovulatory, anovulatory and inactive. Wiltbank et al. (2002) classified the anovulatory anestrus into three classes i.e. anovulation with follicular growth up to emergence; anovulation with follicular growth up to deviation but not ovulatory one; anovulation with follicular growth up to ovulatory size.

Estrus based on the above information's and for the ease, anestrus has been classified accordingly for better understanding (Figure 1).

Anestrus



Ovulatory anestrus	Anovulatory anestrus
1. Sub-estrus	1. Anovulatory anestrus –I
2. Unobserved estrus	2. Anovulatory anestrus –II
3. Presistent corpus luteum	3. Anovulatory anestrus -III

Figure - 1

Physiological Anestrus: Animals remain anestrus during certain physiological stages which does not related to infertility viz., before puberty, during pregnancy, lactation and early postpartum period. Accordingly, physiological anestrus has been classified into pre–pubertal, gestational, lactational and post-partum anestrus.

Prepubertal Anestrus: The reasons of pre–pubertal anestrus includes low LH pulse frequency that results in insufficient growth of follicles and high threshold for positive feedback effect of estradiol on LH surge.

Gestational Anestrus: The elevated level of progesterone during pregnancy exerts negative feedback effect on GnRH secretion from hypothalamus and reduces LH pulse frequency resulting into anestrus. However, some cattle and buffaloes exhibit estrus during early pregnancy (known as gestational estrus) which is seen most often during first four months of pregnancy

Postpartum Anestrus: Following parturition, all the females undergo through anestrus for a variable but short period of time, known as postpartum anestrus. The period of postpartum anoestrus is usually longer in buffalo than the cattle under similar management conditions probably due to low LH secretion during early postpartum period (Perera, 2011) Under normal conditions, buffaloes resume cyclicity by 30–90 days however; only about 45% of Indian buffaloes resume cyclicity within 90 days postpartum and rest 55% remain in anestrus for about 150 daysThe physiological postpartum anestrus cannot be avoided and is useful to allow uterine involution prior to first postpartum anestrus.

Lactational Anestrus:

Higher level of prolactin in high yielding animals suppresses GnRH secretion and ultimately reduces production of gonadotrophins from pituitary, resulting into anestrus.

Pathological Causes Of Anestrus:

Certain pathological conditions i.e. ovarian agenesis, dysgenesis or derangement of

follicular–luteal dynamics leads to anestrus causing infertility and pose a herd problem. Such conditions may be congenital or acquired.

Congenital And Hereditary Causes Of AnestruS:

Ovarian agenesis or aplasia (absence of ovary) is extremely rare condition and probably crop up due to inherited autosomal dominant gene. Bilateral aplastic or gonadless heifers appear normal until breeding age but fail to show estrus and normal development of udder at puberty and are sterile. Such reports from India are meager. Ovarian dysgenesis has been identified as ovarian hypoplasia and freemartin. Ovarian hypoplasia (incomplete development of ovary) is caused by single autosomal recessive gene with incomplete penetration. It may be unilateral or bilateral. The incidence of ovarian hypoplasia in Indian cattle has been reported between 0.08–4.3%. Whereas it is less than 1 per cent in Indian buffaloes with a slightly high incidence (1.46%) in Jaffarabadi buffalo In Free martin (sterile heifer born co–twin with bull calf) the ovaries usually fails to develop and remain hypoplastic resulting into anestrus. The incidence of freemartinism in Indian cattle and buffaloes has been reported low i.e. between 0.10 to 0.20% (Sharma et al., 2004).

Table 1: Incidence of anestrus in India–breeds wise

Breed	Incidence (%)	References
Hariyana cows	0.6–12.13	Khan and Luktuke, 1967
Kankrej cows	11.8–23.8	Agarwal and Buck, 1968
Gir cows	47.89	Kodagali, 1974
Red Kandhari cows	3.0	Pargaonkar and Bakshi, 1987
Deoni cows	2.13	Narladkar et al., 1994
Friesian crossbred	35.96	Sinha et al., 1987
Jersey crossbred	35.5	Sinha et al., 1987
Murrah and upgraded Murrah buffaloes	29.12	Kumar et al., 2013

Anestrus due to persistent corpus luteum (PCL):

In this type of anestrus, the follicular growth proceeds through all the developmental stages and undergo ovulation and CL formation which subsequently turn into anestrus due to failure of luteal regression. This is probably due to absence of estrogenic dominant follicle at the time of luteal

regression) secreting adequate estradiol to induce the formation of uterine oxytocin receptors and consequently resulting in to pulsatile release of PGF2α for luteolysis. Retained corpus luteum may also be associated with embryonic death when death of embryo occurs after maternal recognition of pregnancy where corpus luteum persists until resorption of embryo.

Sub–Estrus/Silent Estrus/Quite Ovulation:

Sub estrus is common during the post pubertal period in heifers and early post–partum (30 to 120 days) in high yielding dairy cows. Progesterone secreted from regressing CL of previous cycle potentiates the action of estrogen and seems to favours the manifestation of estrus in next cycle. Thus, lack of progesterone priming results in sub–estrus. Such conditions have been frequently reported in dairy buffaloes especially in summer months (Singh et al., 2013) and may be the one of the reasons of prolonged calving interval in buffaloes. Other causes of sub estrus are heat stress, nutritional deficiencies, overweight, foot lesions, aging and ergotism (fescue toxicity) but most common cause considered for sub estrus is the failure of estrus detection.

Anestrus Due To Failure To Observe Estrus/Unobserved Estrus:

Estrus detection is critical aspect of dairy herd management where artificial insemination is being practiced. Earlier, it was reported that intensity and duration of standing estrus is shorter in Bos indicus cattle as compared to Bos taurus cattle, probably due to small follicular diameter (Bo et al., 2003). However, recent studies indicate that there is no difference in intensity and duration of estrus between Bos taurus and Bos indicus cowsIn high yielding cows, many times the estrus cycles become irregular in terms of its intensity and duration of standing estrus resulting in low estrus detection rates. The condition may be due to low estrogen concentration, insulin and IGF–I mediated deficiency of follicular growth.

Pathogenesis:

The concentration of gonadotrophins are almost negligible in late gestation and for a short duration following parturition due to strong inhibition of hypothalamic–pituitary axis through negative feedback effect of high progesterone secreted by corpus luteum and placenta and estrogen from placenta during last trimester of pregnancy.

The concentration of FSH rises within 3–5 (ranges 2 to 7) days after parturition

whereas restoration of LH pulsatility and LH surge mechanism takes rather longer period than the FSH (14–28 days). Moreover, growth and maturation of follicle also depends upon bioavailability of insulin, insulin like growth factor (IGF)–I and their binding proteins. Both insulin and IGF–I are potent stimulators of steroidogenesis and granulosa and theca cells proliferation as well as oocytes growth and maturation. Hence, inadequate LH pulse frequency, low concentration of insulin and IGF–I impede the follicular growth and reduces the chance of ovulation. These conditions appear to occur in a state of under nutrition/malnutrition; (Ramoun et al., 2012) and negative energy balance. In a state of negative energy balance, the circulating concentration of non–esterified fatty acid (NEFA) due to mobilization of body reserves and endogenous opioids increases which in turn decreases the pulsatile secretion of LH. Ultimately, follicles become atretic and then regress. The process of follicular growth and regression occurs over and again till the above state of affairs persists resulting into anovulatory anestrus.

Diagnosis Of Anestrus

Based on the information viz., failure of displaying the overt signs of estrus by the animals after attaining puberty or 60–90 days post-partum; Such cases are diagnosed when presented for pregnancy diagnosis. Many times, owners' complaint that they are not able to detect estrus or have not seen any signs of estrus in that particular animal since long.

Progesterone: Estimation:True anestrus is usually characterized by a lack of ovarian progesterone production.Presence of basal level (0.5–1 ng/ml) of progesterone in the blood samples at an interval of 8–10 days further confirms the diagnosis. If the concentration of progesterone is more than 1ng/ml, it is suggestive of presence of corpus luteum and anestrus in such situation might be due to unobserved estrus/silent estrus/persistent corpus luteum.

Per Rectal Examination: Pregnancy can be a prominent cause of anestrus and therefore must be ruled out by careful examination of ovary and uterus when any animals present for gynecological examinations. On per rectal examination, ovaries are smooth, small and inactive with the absence of corpus luteum in true anestrus cattle and buffaloes, however, follicles may develop up to prematuration stage and get atretic (Ghuman et al., 2010). Functional corpus luteum can be palpated in case of silent

estrus/unobserved as well as in anestrus due to persistent corpus luteum.

Ultrasonography: Different stages of follicular growth and type of anestrus can easily be detected by ultrasonography. Transrectal ultrasonographic examination of anestrus buffaloes cows which are not seen in oestrus for 60 or more days postpartum at 12 days revealed 45% inactive ovaries55% silent ovulation or missing heat (Rahman et al., 2012). It can also differentiate between persistent follicle and persistent CL.

Treatment

Anestrus can be treated according to their cause various therapeutic agents including hormonal and non–hormonal compounds have been used extensively for the restoration of cyclicity in anestrus cattle and buffalo by several workers. In order to ensure effective treatment, the health and nutritional status of the animals must be in good conditions. Besides deworming, the supplementation of vitamins, minerals and antioxidants in feed are useful to improve health status of the animals.

Utero–Ovarian Massage: Utero–ovarian massage is the oldest, simplest, cheapest and effective method to induce estrus in anestrus cattle and buffaloes Estrus induction in cattle and buffalo varies between 40 to 80% following utero–ovarian massage daily/on alternate day/weekly for 3–4 weeks

Lugol's Iodine Lugol's iodine treatment is cheaper and effective means of management of anestrus but response has been variable (45 to 91.7%) among cattle and buffaloes. It is presumed that painting of Lugol's iodine on posterior part of the cervix causes local irritation and brings about reflux stimulation at anterior pituitary for secretion of gonadotrophins and consequently cyclicity.

Estrogens Based Treatment Exogenous administration of estrogen produce estrus signs in anestrus animals with or without concurrent ovulation. In presence of dominant follicle, estrogen administration results in expression of estrus and ovulation because of its positive feedback effect over pituitary for LH surge.

Progesterone Based Treatment: Exogenous administration of progesterone mimics the luteal phase of the estrus cycle by exerting negative feedback effect over hypothalamus and pituitary for LH release. Upon withdrawal of progesterone, the normal follicular phase of the cycle is stimulated. However, for such treatment seem to be effective, abrupt decrease in progesterone level is required at the end of treatment.

Treatment with CIDR: The addition of GnRH and eCG to a progesterone-based

CIDR protocol substantially improves the estrus induction and pregnancy rates in postpartum anestrous buffaloes (Azawi et al., 2012).

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Edible Bio Packaging Materials and Its Application in Meat Products Processing

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Food packaging materials protect food from physical, chemical and biological hazards such as moisture, light, gases, aromas and microorganism by maintaining its quality and prolongs it's shelf life. Packaging requirements of food are much more stringent than for most other commodities. At present the most commonly used packaging materials for food are metals, glass, plastics, foils and paper boards. As they are non edible they have to be removed from package at the time of use. The use of synthetic films has led to big ecological problems because these materials are non-biodegradable. It is estimated the packaging materials generate approximately 30 per cent by weight of municipal waste. Out of 30 per cent packaging waste, 13 per cent is due to plastic materials which are not biodegradable. Increasing environmental issues, awareness among consumers and growing market of convenience foods have augmented the need for development of packaging material which is easily recyclable or preferable edible. The problems in disposing of the huge quantities of waste generated by non-biodegradable food packaging have led to the study of biopolymers as materials to be used as edible coatings in food packaging.

Bio polymer packaging

Biodegradable polymers are derived from replenishable agricultural feed stocks, animal sources, marine food processing industry wastes or microbial sources. Because of environmental issues of packaging materials, edible films and coatings offers alternative of eco-friendly packaging system. The natural biopolymers that are used in food packaging have the advantages to be available from replenishable resources, biocompatible, biodegradable. The structure of monomer used in polymer preparation is directly effective on the properties that are required in different areas of work such as thermal stability, flexibility, good barrier to gases, good

Functional properties – Barrier against	**Bio polymers flims**			
	Polysaccharides	Lipids	Proteins	Composite flims
Water	× +	+	× +	+
Water vapour	×	+	×	+
Oxygen	+	×	+	+

Classification and characteristics of bio polymers packaging

Biopolymer based packaging materials originated from naturally renewable resources such as polysaccharides, proteins and lipids or combinations of those components have the potential to replace current synthetic plastics. Some authors classified the polymers according to the method of production or their source as

- Polymers directly extracted or removed from vegetal or animal biomass such as polysaccharides and proteins.
- Polymers produced by classical chemical synthesis starting from renewable bio-based monomers such as polylactic acid (PLA).
- Polymers produced by microorganisms such as polyhydroxyalkanoates, cellulose, xanthan, pullulan.

The functional properties of bio polymer edible films and coating are similar to those of synthetic packaging films. Edible flims are usually formed as free – standing thin sheets, while edible coatings are thin flims formed directly on the food product. Besides being biodegradable and compostable, edible films are act as barriers against moisture, oxygen, oil and solute migration. Bio polymer based edible films and coatings can also improve the mechanical handling of food products including meat products. Edible films can also be used to retain volatine flavor compounds and even for binding specific food additive.

Polysaccharide films

Polysaccharides used for edible films or coatings and are made from cellulose, starch derivatives, pectin derivatives, cellulose, seaweed extracts, exudate gums, microbial fermentation gums and chitosan. These flim materials have a high degree of interaction amongst their polymer chains. This restricts chain motion, resulting in low gas permeability. Polysaccharides are generally very hydrophilic resulting in poor water vapor and gas barrier properties. Additionally,

polysaccharide films and coatings can be used to extend the shelf-life of muscle foods by preventing dehydration, oxidative rancidity and surface browning. When applied to wrapped meat products and subjected to smoking and steam, the polysaccharide film actually dissolves and becomes integrated into the meat surface. Meats treated with the polysaccharide film in this manner exhibited higher yields, improved structure and texture, and reduced moisture loss. Edible starch based films can retard microbial growth by lowering the water activity within the package, thereby reducing drip loss of meat products and binding water that otherwise would be available for microbial growth. Desirable properties attributed to alginate films, include moisture retention, reduction in shrink, improved product texture, juiciness, color, and odor of treated muscle foods. Carrageenan based coatings have been used to prolong the shelf life of a variety of muscle foods including poultry and fish. Cellulose casings also are widely used by the meat industry in the manufacture of ready-to-eat meat and poultry products, including frankfurters, sausages, bologna, and other small diameter meat products subject to thermal processing. Currently, very little information exists to the application of pectin-based edible films on muscle foods. Next to cellulose, Chitosan is the most abundant natural polymer available. Some desirable properties of chitosan are that it forms films without the addition of additives, exhibits good oxygen and carbon dioxide permeability, as well as excellent mechanical properties and antimicrobial activity against bacteria yeasts, and molds. However, one disadvantage with chitosan is its high sensitivity to moisture.

Lipid films

Edible lipid or resin coatings can be prepared from waxes (e.g., carnauba, beeswax, and paraffin), oils (vegetable, animal, and mineral) and surfactants. There are a number of advantages for coating foods with lipids. These flims have good moisture barrier properties because the tightly packed crystalline structure of lipids restricts the passage of water vapour molecules. However, lipid coating lack structural integrity and do not adverse well to hydrophilic cut surfaces. Enrobing muscle foods with fats, has been performed primarily to reduce shrinkage of the food product, as well as to provide oxygen or moisture barriers. However, lipid-based films are vulnerable to oxidation, racking, flaking, retention of off-flavors, as well as bitter aftertastes. Waxes are used as barrier films to gas and

moisture (skin on fresh fruits) and to improve the surface appearance of various foods waxes (notably paraffin, carnauba, candellila and bee wax) are the most efficient edible compounds providing a humidity barrier. Most lipids in the solid state can be stretched to only about 102% of their original length before fracturing. Acetylated glycerol monostearate, however, can be stretched up to 800% of its original length. Acetylated monoglyceride coatings have been used on poultry and meat cuts to retard moisture loss during storage.

Protein films

Casein, whey protein, gelatin/collagen, fibrinogen, soy protein, wheat gluten, corn zein, and egg albumen have been processed into edible films. Due to their hydrophilic nature, these materials have good filim forming properties, but no resistance to water vapour in a high relative humidity environment. Protein films are generally formed from solutions or dispersions of the protein as the solvent/carrier evaporates. The solvent/carrier is generally limited to water, ethanol or ethanol-water mixtures. Protein-based films adhere well to hydrophilic surfaces, provide barriers for oxygen and carbon dioxide, but do not resist water diffusion. Casein and whey are the two common milk proteins that have been used in the manufacture of edible films. These proteins are desirable as components of these films because of their nutritional value, excellent mechanical and barrier properties, solubility in water, ability to act as emulsifiers, and because of their industrial surplus. Additionally, the application of protein films to muscle foods may present health problems, especially for individuals with food allergies associated with milk, egg, peanut, soybean, or rice proteins. Gelatin films could be formed from 20-30% gelatin, 10-30% plasticizer (glycerin or sorbitol) and 40-70% water followed by drying the gelatin gel. In addition, gelatin films have been formed as coatings on meats to reduce oxygen, moisture and oil transport. Zein has excellent film forming properties and can be used for fabrication of biodegradable films. Zein films are relatively good water vapor barriers compared to other edible films. Gelatin/collagen based edible films also may serve as gas and solute barriers, thereby improving the quality and shelf life of muscle foods. These commercially available collagen films have been purported to reduce shrink loss, increase permeability of smoke to the meat product, increase juiciness, allow for easy removal of nets after cooking or smoking,

and absorb fluid exudates. Limited information exists on the use of cereal and oil-seed proteins as edible films for meats. Soy protein can be used in the manufacture of adhesives, plastics, and packaging materials and can be a good alternative to the petroleum polymers. Whey proteins are a by-product from the cheese industry, and consist of whey protein isolates and whey protein concentrate. Whey proteins are capable to form elastic films and they have been employed as raw material for biodegradable packaging because they have good oxygen barrier and moderate moisture permeability.

Composite films

Composite flims consisting of lipids and hydrocolloids (proteins or polysaccharide) combine the advantages of each. This approach enables one to utilize the distinct functional characteristics of each class of film former. The combination between polymers to form films could be from proteins and carbohydrates, proteins and lipids, carbohydrates and lipids or synthetic polymers and natural polymers. The main objective of producing composite films is to improve the permeability or mechanical properties as dictated by the need of a specific application. These heterogeneous films are applied either in the form of an emulsion, suspension, or dispersion of the non-miscible constituents, or in successive layers (multilayer coating or films), or in the form of a solution in a common solvent. Two or more materials can be combined to improve gas exchange, adherence to coated products, or moisture vapor permeability properties.

Application of biopolymers in meat and meat products

The application of edible films to meat products is accomplished by indirect or direct application. For direct application, a number of methods have been employed including foaming, dipping, spraying, casting, brushing, wrapping or rolling. For foam applications, a foaming agent may be added to the coating or compressed air blown into the applicator tank. Then, the edible biopolymers foam is applied to the meat food by flaps or brushes as it moves over rollers. In some instances, submerging the meat products into a tank of the emulsion may work best, especially when applying several coats, when smoothing out irregular surfaces, or when costs need to be controlled. After dipping, the excess coating usually drips off and the remaining material is allowed to set or solidify on the meat product. In some cases, a heated air drier may be applied to

speed up the setting process or to remove excess water. When a thinner, more uniform biopolymers edible film is required for certain surfaces, films may be best applied by spraying. Spray applications are also suitable when applying films to a particular side or when a dual application must be used for cross-linking, as is practiced with alginate coatings. Just as with foams, heated air can be applied after spraying to speed up the drying process or improve uniform distribution on the surfaces. With regard to indirect application of bio-based films to meat products, casting technologies may be employed. In this process, film-forming solutions may be poured onto a smooth, flat and level surface, with or without a mold to contain the solution, and allowed to dry or set. When performed in this manner, casting produces freestanding films with a desired thickness, smoothness, and flatness. When handled or processed as described, cast films may be firm and flexible enough to be wrapped around product surfaces. When it comes to applying films, gels or coatings to muscle foods, they should exhibit a number of functional properties such as moisture barrier ability, water or lipid solubility, color, appearance, transparency, desired mechanical or rheological characteristics and be non-toxic. These properties can be influenced by the addition of compounds including plasticizers, cross-linking agents, antimicrobials, antioxidants or textural additives. Not only should these films exhibit flexibility, permeability, gas and solute migration or porosity following incorporation of these additives, but these films also should be resistant to breakage and abrasion.

Conclusions

Biopolymers packaging materials have been developed from polysaccharides, proteins, and lipids or combinations of those components have the potential to replace current synthetic plastics. Biopolymers packaging is gaining interest from researchers and meat industry due to its biodegradable and compostable characteristics. Bio based edible, or biopolymer packaging extends the shelf life and imparts desirable characteristics to the processed meat and poultry products. Biopolymers have vast diversity and therefore their applications in meat and poultry products packaging are various and multiple.

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Appraisal of Cattle and Buffalo Breeding Programme In India

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India possesses 37 indigenous breeds of cattle and 13 breeds of buffaloes. Various central and centrally sponsored schemes are being implemented for genetic improvement of cattle and buffalo with a view to enhance the per capita availability of consumption of milk through increased milk production. Efforts are also made to protect and preserve the indigenous cattle and buffalo in their native tract which are facing threat of extinction. The elite animals are selected and registered on the basis of their performance for production of superior pedigree bulls, bull mothers, frozen semen and frozen embryos for future breeding improvements.

According to 18th Livestock Census (2007) estimates about 16.21 and 58.21 per cent of world cattle and buffalo population are available in India. The total bovine (cattle and buffalo) population is about 57.5 % of the livestock of the country and the cattle and buffaloes are 191.2 and 102.4 million respectively. Among cattle population, only 5.20 % population are considered as crossbred whereas 94.80 % are indigenous animals. The trend of breedable bovine population including heifers shows an overall increase of 59.00 % for crossbred animals, 35.77 % for indigenous cattle and 95.22 % for buffaloes during 1951 to 2003 in the country. The zone-wise bovine population shows that north zone including Haryana possesses highest number of buffaloes, south zone have largest crossbred cattle where as east zone have maximum number of indigenous cattle population.

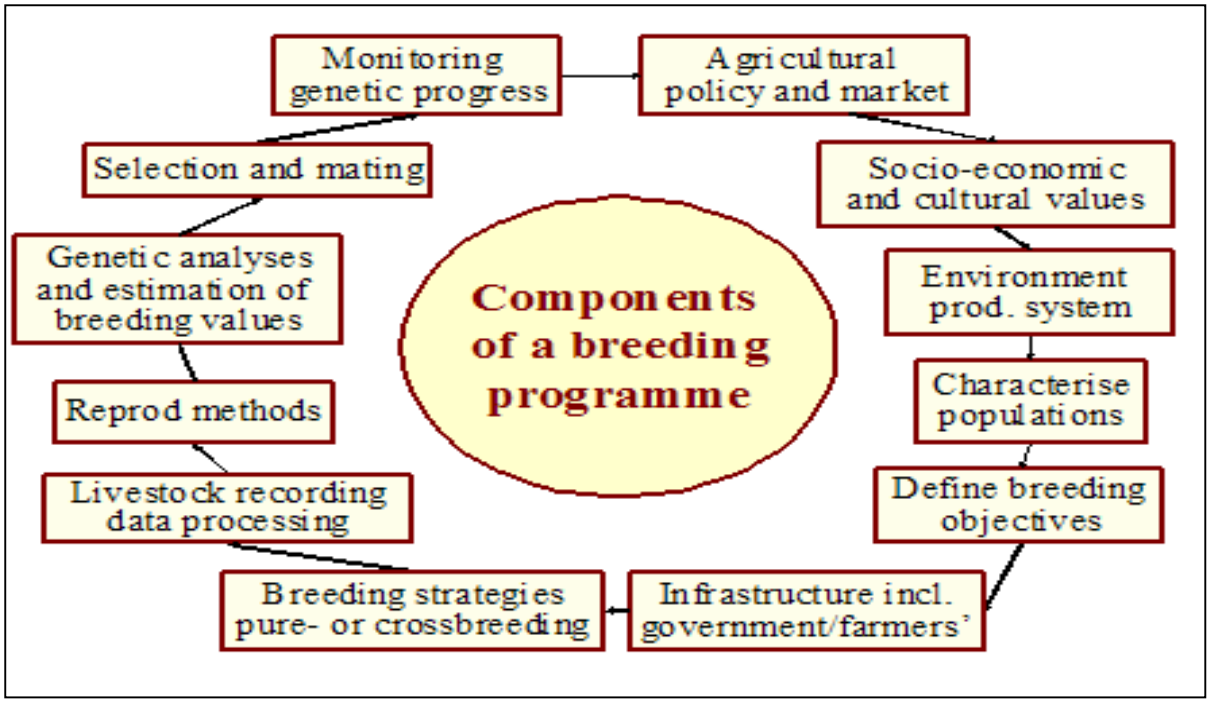
India with a production of 131 million tons of milk in 2013-14 is the leading country in the world in terms of total milk production. In 2012, the country contributes about 17 % of the world's milk production. The annual growth rate of milk production increased from 2.91 % in 5th Five Year Plan (1975-1979) to 6.65 % in 10th Five Year Plan (2002-2007) in the country. From 1951 to 2009, the growth of milk production has jumped more than six times and as a result the per capita

availability of milk has reached to 261gm milk per day in 2013-2014.

All these above improvements are due to many steps taken up by the animal husbandry department (AHD) with goal for nutritional food security. This is possible through key developments in 5 year plans with establishment of many dairy development projects and suitable breeding policies specific to the native tracts of various breeds.

Table No.1 : Major milestones of dairy development in India

Year	Developments
1886	First Military Dairy Farm set up at Allahabad
1907	First importation of Ayrshire stock.
1920	Scientific breeding, feeding and management practices to be followed at Military dairy farm
1944	Central Livestock and Research cum Breeding Station started at Haringhata.
1948	The First Farmers integrated dairy Co-operative - The Kaira District Cooperative Milk Producers' Union was established at Anand which came to be known as Amul.
1952	Central Council for Go samvardhan set up a central coordinating agency on cattle development
1969	Intensive cattle development project (ICDP)
1970	Operation Flood Project was initiated. This was the World's biggest milk drive launched in country.
1975	A Karan-Fries cow at NDRI established a record of highest milk production 44 Kg. Daily Peak yield
1993	Intensive dairy development program (IDDP)



For the genetic improvement or up gradation of indigenous cattle and buffalo population, it needs strategic breeding policies with suitable breeding methods. Some of these methods of breeding are described below.

Breeding Methods

A. Inbreeding

Inbreeding is the mating of closely related individuals whose relationship is more than the average relationship of the population. Example is the individual having one or more common ancestors or relatives. Inbreeding may be mild or close.

Advantage:

i) Undesirable recessive genes may be discovered and eliminated by further testing in this line.

ii) The progeny are more uniform. It increases homozygosity and decreases genetic variance.

iii) Breaking down of population into different inbreed lines.

Disadvantages

1. The progeny becomes more susceptible to diseases.

2. Breeding problems and reproductive failure usually increases.

3. It is difficult to find out the stage of breeding at which it should be discontinued in order to avoid the bad effects of the system.

4. It depresses vitality in early life than in later life.

Close inbreeding:

In this type of inbreeding, mating is made between very closely related individuals such as full brothers are crossed with full

sisters or offsprings are crossed with parents.

Line breeding

It is repeated back crossing to one outstanding ancestor, so that its contribution to the progeny is more. In this type of breeding, matings are made to concentrate the inheritance of desired characters of some favoured individuals.

a) It brings about the uniformity of the required type.

b) The dangers involves in case in breeding can be reduced.

B. Outbreeding

It is the opposite of inbreeding. Mating of unrelated animals is known as out breeding. It is divided into six classes as detailed below.

1. Pure breeding
2. Line Crossing (Crossing of inbreed lines)
3. Out Crossing
4. Cross Breeding
5. Grading up
6. Species Hybridisation

1. Pure breeding

It is mating of male and female belonging to the same breed.

The examples of pure breeding are

- Ongole Cow X Ongole bull
- Jersey Cow -x Jersey Bull
- Murrah she buffalo x Murrah bull

The outstanding advantage of pure breeding is for production of bulls for breeding purpose. Only pure breeding is to be followed in almost all the breeds except in case of inter-se-mating. It avoids mating of closely related individuals.

2. Line crossing

Synonym is the crossing of inbred lines. In this method of breeding, first closely inbred lines are developed by intensive inbreeding of more than 5 generations and then crossing is done to develop progeny from 2 unrelated lines for the male and for the female. The unrelated inbred line male is mated to the inbred line of female and the offspring born out of such mating becomes a hybrid which exhibits heterosis or hybrid vigour.

3. Out crossing

It is mating of unrelated pure bred animals in the same breed. The animals do not have common ancestors on either side of their pedigree up to 4 to 6 generations and the offsprings of such a mating is known as the Out cross.

Advantage: It is an effective system for genetic improvement if carefully combined with selection. It is also pure breeding.

4. Cross breeding

It is mating of animals of different breeds. Cross breeding is followed for breeding animals for milk production and meat production. In India zebu breeds of cows

and nondescript cows are crossed with exotic breeds like Holstein Friesian, Brown Swiss and Jersey bulls or their semen to enhance the milk production potential of the progeny.

Advantage

1. The desirable characters of the exotic parent are transmitted to the progeny which the indigenous parent does not have.
2. In India Cross-breeding of cows is done by using the exotic bulls and the progeny inherit the desirable characters of the parent like high milk yield, early maturity, higher birth weight of calves, better growth rates, better reproductive efficiency and indigenous parents characters like heat tolerance, disease resistance ability to thrive on scanty feeding and coarse fodder etc.

Disadvantages

1. The breeding merit of cross breed animals may be slightly reduced.
2. Cross breeding requires maintenance of two or more pure breeds in order to produce the cross breeds.

At present cross breeding work is going on at (MDF) Military dairy farms, NDRI (Karnal), All India coordinated Research projects on Cattle, Collaboration projects like Indo-Swiss, Indo-Australian, Indo-Danish projects and also in the field in farmer's herd.

In general the cross breeds were found to have higher birth weight, faster growth rate, earlier age at first calving, higher weight, at first calving, higher lactational yield, longer lactation period, shorter service period, dry period and milk production and breeding efficiency.

5. *Grading Up*

Grading up is the practice of breeding in which the sires of the exotic breed are mated with the non-descript females and their off-spring from generation to generation. After five or six generations of grading up, a population resemble the exotic breed with 96.9 % to 98.4 % of exotic inheritance.

Advantages

1. After 5 to 6 generations grades resembling pure bred animals in matter of physical appearance and production can be obtained.
2. Grading up avoids much expenditure of purchasing the exotic females herd of animals as grading up is carried on with a few exotic bulls and the indigenous female animals.
3. It proves the breeding merit of the exotic bulls used.
4. The value of the graded animals is much enhanced.

Disadvantages

1. The graded males are useless for breeding purpose.

2. The climate and the environment that is suitable for the exotic breed only is suitable for grading also. If the place is not suitable for the exotic breed it is not suitable for grading with that breed.

Cattle and Buffalo Development Programmes in India

For all round development of Cattle wealth in the different parts of the State, various development programmes such as

- Central Cattle Breeding Farms (CCBF)
- Intensive Cattle Development Projects (ICDP) for cross breeding and up gradation.
- Central Herd Registration Scheme (CHRS)
- Central Frozen Semen Production
- National Project for Cattle and Buffalo Breeding (NPCBB)
- Bovine Genetic Resources and Breeding Policies

Conclusion

In India the major breeding goals of dairy animals is to improve the milk production in general and productivity of dairy animals in particular through the maximum exploitation of genetic resources so that the country meets the projected demand of milk at about 140 million tones by the end of 2020 and increase the nutritional and livelihood security through increasing the economy of rural masses.

Management of Physiological Disorders in Mango

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Mango (*Mangifera indica* Linn) is undoubtedly the most important fruit crop of India with great cultural, economic and religious significance. Mango is also one of the most favoured fruits among all sections of the society in India. Due to its high palatability, excellent taste, flavour and exemplary medicinal and nutritive values, it is regarded as the king of tropical fruits. As per National Horticulture Board at Gurgaon, in the year 2012-13, India produced about 18002 thousand tonnes of mangoes from 2500 thousand hectares with an average productivity of 7.2 t/ha. Mango is grown almost in all the states of India. Andhra Pradesh tops the list of mango producing states. Other major mango producing states are Uttar Pradesh, Karnataka and Bihar. India accounts for about 45% of the mango and guava produced globally. India exported 55585 MT of fresh mangoes valued at Rs. 26472 lakhs during 2012-13. India exports mango to over 40 countries worldwide. The major importing countries of Indian mangoes during the period of 2012-13 were UAE, UK, Saudi Arabia and Qatar. In the year 2010, Brazil had the highest mango productivity *i.e.* 16 t/ha. Owing to increasing population and shrinking land, it is imperative that we increase the productivity of mango. Lack of good quality planting material, old and overcrowded orchards, poor orchard management, physiological disorders and climate change have prevented any appreciable increase in mango productivity. The yield and quality of mango across the country is often compromised by some major physiological disorders such as biennial bearing, fruit drop and mango malformation. Spongy tissue a physiological disorder in Alphonso mango has severely hampered its export potential.

Physiological disorders refers to the breakdown of tissues in response to

adverse environmental conditions especially temperature or to a nutritional deficiency during growth and development. It does not include mechanical damage or damage by pests/pathogens. Some important physiological disorders affecting mango, their possible causes and suggested corrective measures are discussed below.

Biennial Bearing

The term biennial, alternate or irregular bearing generally signifies the tendency of mango trees to bear a heavy crop in one year (on year) and very little or no crop in the succeeding year (off year). Most of the commercial varieties in north India, namely, Dashehari, Langra and Chausa are biennial bearers, while South Indian varieties like Totapuri Red Small, Bangalora, and Neelum are known to be regular bearers.

Causative Factors: Generally mango trees when laden with fruits, do not produce new shoots. Even after harvesting, if new shoots are produced, they are negligible in number and do not flower in the coming year because new vegetative flush of mango required a certain amount of maturity (8-10 months) for flower bud differentiation. Normally if this year it flowers and fruits, next year new shoots will be produced in the months of March-April which flower again in the next year resulting in flowering and fruiting in alternate years. Moreover, when a tree produces heavy crop in one season, it gets exhausted nutritionally and is unable to put forth new flush thereby failing to yield in the following season. This problem has been attributed to genetical, physiological, environmental and nutritional factors.

Management Strategy: For overcoming biennial bearing, deblossoming is recommended to reduce the crop load in the 'On' year so that it is balanced in the 'Off' year. Deblossoming of some 'on year' flowers and pruning of the tree just after harvesting will maintain proper physiological balance between vegetative and reproductive growth and permit ample amount of sunlight to reach the inner area of the orchard resulting in better performance of the tree every year. Moreover pruning also helps to produce some new shoots just after harvesting which may mature in the next flowering season. Soil application of Paclobutrazol (PP $_{333}$) or Cultar @ 4 g/tree in the month of September resulted in early flowering with higher fruit set and yield. It may be applied every year for regular fruiting, particularly in young trees. Foliar sprays of postassium nitrate (KNO_3) can induce

flowering, particularly in tropical areas where the temperature does not go low enough to trigger flowering. Countries such as Philippines, Mexico, Trinidad, Ivory Coast and the state of Hawaii in USA, have reported success in the stimulation of flowering with the application of potassium nitrate at concentrations ranging from 1 – 8 percent. However, in India, the results are variable and need further investigations. Growers can opt for hybrids like Amrapali, Mallika, Ratna, Dashehari-51, Pusa Arunima, Pusa Shrestha, Pusa Pitambar, Pusa Lalima, Pusa Pratibha, Arka Anmol, Arka Aruna, Arka Puneet, Arka Neelkiran for commercial cultivation as they are regular bearing in nature. Rejuvenation of old mango orchards by grafting regular bearing varieties is also recommended to convert the alternate bearing orchards into regular bearing one's. Proper maintenance of orchard by way of effective control of pests and diseases and regular cultural operations may also result in better performance of the tree every year.

Fruit Drop

In mango, there is a heavy drop of hermaphrodite flowers and young fruits amounting to about 99% or more. In general, in mango 0.1% or less hermaphrodite flowers develop fruits to maturity Fruit drop, to a certain extent is associated with the variety, as 'Langra' is more prone to fruit drop than 'Dashehari. It appears to be a continuous process and can be classified into three phases, viz. (i) pinhead drop, (ii) post-setting drop and (iii) May-month drop. Fruit drop in the first two phases is insignificant as compared to the third phase which affects the final yield significantly.

Causative Factors: Fruit drop is a complex phenomenon influenced by cultivar, cultural practices and environmental factors. Self incompatibility; inadequate pollination; unsuccessful fertilization; embryo degeneration; defective perfect flowers; low stigmatic receptivity; poor pollen transfer; high/low temperature and strong winds; nutritional and hormonal imbalances; insect pests (mango hopper and mealy bug) diseases (powdery mildew and anthracnose) and moisture stress and competition among developing fruits are mainly responsible for fruit drop in mango.

Management Strategy: Fruit drop can be effectively minimized by spraying 2, 4-D at 20 ppm at pea stage. A single spray of NAA at 20 ppm or Alar at 100 ppm also reduced fruit drop. At IARI, CPPU when applied at 0.1% in the first week of May retarded fruit drop in cv. Langra. Application of spermine

(0.01mM) at the pea stage followed by another spray 20 days thereafter, led to a substantial improvement in fruit retention in cv. Kesar at Navsari. Two sprays of 0.25 ppm 28-homobrassinolide at 20 days interval starting from 100% flowering stage gave higher fruit set and yield in mango cv. Kesar at NAU, Navsari. Urea and KNO_3 sprays ranging in concentration from 1 to 4 % applied at full bloom have been shown to increase fruit retention. Foliar sprays of 0.2 to 0.8 % $ZnSO_4$ and boric acid applied at late bud swell stage have also resulted in increased fruit retention. Work done at Navsari Agricultural University revealed that a single foliar spray of $ZnSO_4$ (1%) + $FeSO_4$ (1%) + Borax (0.5%) reduced fruit drop and increased fruit retention in cultivar Alphonso when sprayed before the initiation of flowering under South Gujarat conditions. Apart from these, regular and frequent irrigation during the fruit development period, planting of wind breaks around the orchard and timely plant protection measures can also reduce fruit drop in mango.

Spongy Tissue

The occurrence of 'spongy tissue' in mango cv. 'Alphonso' was first noted in 1932 by Cheema and Dani. It is a serious problem in Alphonso orchards of Maharashtra (Ratnagiri, Konkan) and Gujarat (South Gujarat). Affected fruits are unfit for human consumption due to poor quality and unacceptable flavour. Over all losses due to

this disorder are estimated to be about 30%. Affected fruits appear normal and this disorder can be detected only after the fruits are sliced open or by using non-destructive X-ray imaging technique. This has hampered the export of this variety.

Symptoms: In this disorder, a non-edible sour, yellowish sponge like patch develops in the mesocarp of the ripening fruit. The affected fruit tissue is visible only when the fruit is cut. Affected fruits have a bad odour and are unpalatable.

Causative Factors: Several reasons have been assigned to this disorder viz., inactivation of the ripening enzyme due to high temperature; convective heat and pre harvest exposure to sunlight.

Management Strategy: This problem can be minimized by harvesting fruits slightly

before maturity around a specific gravity of 1.01 – 1.02; keeping interspaces covered with mulch or sod cultivation; keeping fruits under shade immediately after harvest and growing cultivars free from spongy tissue like Sonpari, Swarna, Ratna, Arka Puneet, Arka Aruna *etc*.

Mango Malformation

Malformation is the most serious threat to mango cultivation in India. It is an important malady in Punjab, Delhi, Bihar, Madhya Pradesh and Uttar Pradesh. It was first reported from Darbhanga in Bihar by Maries. Mango malformation has become a national problem affecting production in more or less all mango growing regions. The severity of this disorder varies with the age of the tree, prevailing temperature, season, region and variety. Generally, late blooming varieties are less susceptible to malformation than the early blooming ones. Almost all commercial cultivars have become susceptible to mango malformation. Bhadauran, a monoembryonic variety and Ellaichi were found free from malformation. In recent studies, cv. Meghaltan from West-Bengal and cv. Dahiyar from Rewa, Madhya Pradesh were reported to be free from mango malformation. Owing to inferior quality, these varieties are not cultivated commercially. Nevertheless, they can be used in resistance breeding against malformation.

Symptoms: It is noticed in seedlings, saplings and floral organs and causes gross distortions of vegetative and floral tissues in mango.

Vegetative Malformation (VM):

Vegetative Malformation (VM) is more commonly observed in young seedlings. Seedlings produce small shootlets bearing

small scaly leaves with a bunch like appearance on the shoot apex. Hence, the apical dominance is lost and seedlings remain stunted. Numerous vegetative buds sprout producing hypertrophied growth, which constitutes vegetative malformation. The seedlings, which become malformed early, remain stunted and die while; those getting infected later resume normal growth above the malformed areas.

Floral Malformation (FM):

Floral Malformation (FM) is the malformation of panicles. The primary,

secondary and tertiary rachises become short, thickened and hypertrophied. Such panicles are greener and heavier with increased crowded branching. These panicles have numerous flowers that remain unopened and are predominantly male and rarely bisexual. The ovary of malformed bisexual flowers is exceptionally enlarged and non-functional with poor pollen viability. Both healthy and malformed flowers appear on the same panicle or on the same shoot. The severity of malformation may vary on the same shoot from light to medium or heavy malformation of panicles. The heavily malformed panicles are compact and overcrowded due to larger flowers. They continue to grow and remain as black masses of dry tissue during summer but some of them continue to grow till the next season. They bear flowers after fruit set has taken place in normal panicles and contain brownish fluid. Floral malformation can reduce fruit yield by as much as 50-80 percent.

Causative Factors: Various causes have been attributed to this phenomenon from time to time viz., cultural practices, nutritional practices, viruses, mites and fungi. However, the picture is still confusing and a general consensus on the precise casual organism or substance is yet to be reached. It is reported to be caused by *Fusarium moniliforme var. subglutinans*. It is postulated that *Fusarium moniliforme* may be producing malformins which may cause malformation. However, no fungicidal treatment has been able to control mango malformation.

Management Strategy: Controlling measures for mango malformation have shown inconsistent results for a reduction in the incidence of this disorder was observed in some orchards but not in others. However, a combination of controlling measures could result in better control of this malady. The most effective strategy against malformation would be the use of pathogen-free nursery stock and growing cultivars resistant to malformation. The vegetative and floral malformed parts should be removed and

either burnt or buried in the soil. Moderate pruning of shoots bearing malformed panicles in the month of January at panicle emergence stage proved effective in suppressing the incidence of malformation in cv. 'Dashehari. Light pruning followed with NAA @ 200 ppm application in October reduced the incidence of malformation in the following season. Spraying malformed parts with mangiferin Zn++ and mangiferin Cu++ chelates was able to control this malady. Application of methanol extract of lead of *Ruellia tuberosa* L. @ 12g leaves per litre extract in October reduced the incidence of floral malformation in mango cv. Dashehari Aman. Floral malformation in highly susceptible cv. Amrapali was reduced significantly with the application of MH (50 ppm) in February at bud burst stage followed by GA (25 ppm) after 24 hrs. Measures such as sanitary pruning, incorporation of organic matter into the soil, control of vectors, judicious water management, balanced chemical fertilization, protection of new buds and weed control may keep the disease severity below the economic loss level. Use of PCR-based method (species-specific primers) for accurate detection of *F. mangiferae* in plants could prove useful in preventing the introduction of this pathogen into new germplasm. Indian Agricultural Research Institute (IARI), New Delhi has developed four new hybrids namely Pusa Peetamber, Pusa Pratibha, Pusa Shreshth and Pusa Lalima which are regular bearing with higher pulp content, longer shelf life and are reportedly resistant to mango malformation. Mango growers should be encouraged to take up the cultivation of such hybrids.

Black Tip

Black tip was first reported by Woodhouse in 1908 from Bihar, India. The damage

caused by this malady has assumed an alarming proposition in states such as West Bengal, Uttar Pradesh, Punjab and Bihar, especially near towns and industrial areas.

Symptoms: The distal end of affected fruit turns black and becomes hard. These fruits ripe prematurely and become unmarketable.

Causative Factors: This disorder generally occurs in orchards located within a distance

of 600 m from brick kilns. Fumes (carbon dioxide, sulphur dioxide and acetylene) emanating from brick kilns are suspected to be responsible for black tip. In addition to these, other factors such as, irrigation, condition of the tree and management practices also play an important role in deciding the severity of the disorder. 'Dashehari' is reported to be highly susceptible while 'Lucknow Safeda' is the least susceptible amongst different varieties.

Management Strategy: Black tip can be minimised by a single spray of 1% borax (10 g/litre) at the pea stage followed by two more sprays at an interval of 15 days. Alternatively, three sprays of 0.6 % solution of borax (600g of borax mixed in 100 litres of water) plus a sticker also reduced black tip. Alkaline solutions such as 0.8% caustic or 0.5% washing soda are also effective. Restricting new kiln sites to a safe distance of at least 1.8-2.0 km in the north and south direction of the orchard may reduce incidence of black tip. Use of telescopic chimneys (15-18 m high) can also be helpful.

Clustering (Jhumka)

This disorder was first observed in U.P. during 1984. 'Jhumka is characterized by good initial fruitset in bunches at the tip of panicles. Such fruitlets cease to grow

beyond pea or marble stage and drop down without attaining full size. These fruitlets are dark green in colour with a deeper curve in the sinus beak region as compared to normal developing fruits. Fruitlets resemble unfertilized fruits which drop down very quickly after turning yellow or developing fruits which split longitudinally. Colour development ceases and the affected fruits remain on the panicle for a considerable period of time. Retention of these fruitlets for a longer period gives the general impression that there will be a good set. However, these fruitlets do not grow any further. Dashehari variety is more prone to this disorder.

Causative Factors: The main cause of 'Jhumka' is the absence of a sufficient

population of pollinators in the orchards, indiscriminate spraying against pests and diseases, use of synthetic pyrethroids, monoculturing of 'Dashehari' and bad weather during flowering. Emergence of vegetative growth during fruitset and development, lead to diversion of photo assimilates to the vegetative growth from the fruitlets resulting in drop of fruitlets. Higher incidence is observed in overcrowded and old orchards.

Management Strategy: Introduction of beehives in the orchards during the flowering season for increasing the number of pollinators and restricting insecticidal sprays at full bloom to avoid killing of pollinators can help solve this problem. Pests and diseases should be controlled in time by spraying the recommended pesticides at the recommended concentrations. Spraying 300 ppm NAA during October-November is recommended. Monoculturing should be avoided, particularly in case of 'Dashehari', 5-6% of other varieties should be planted in the orchard. Top working old orchards with improved varieties as pollinizers can also reduce its incidence.

Soft Nose

Soft nose is considered to be similar to tip pulp or as an advanced stage of flesh breakdown or of stem end rot cavity or a combination of jelly seed and SEC. In Indonesia, soft nose and tip pulp are considered to be identical to yeasty fruit rot or insidious fruit rot. However, there are macroscopic differences among jelly seed, soft nose and SEC. Each of these disorders affects different areas of the fruit.

Symptoms: Soft nose can be described as a partial ripening of the mesocarp at the distal end of the fruit, which in its early stage results in a defined yellow area between the apex of the stone and the exocarp. The mesocarp of the affected fruits showed cell separation and cell wall degeneration with soft nose, whereas cell cohesion is maintained in the healthy mesocarp.

Causative Factors: Ca deficiency has been implicated as the most probable cause, because the incidence of soft nose was correlated with low Ca concentrations in leaves and fruit. Varietal differences are observed in the susceptibility to this disorder. Soft nose was only observed in fully developed fruit (14 weeks after fruit set).

Management Strategy: Application of calcium and proper post harvest handling may reduce soft nose incidence.

Stem-end cavity (SEC)

Stem-end cavity symptoms appear 8 weeks after fruit-set (WAF) in 'Tommy Atkins' and 'Van Dyke' while after 12 WAF in 'Irwin' cultivar of mango, when the average fruit weight is approximately 10-17% of the final weight of the fruits.

Symptoms: SEC symptoms are similar to those of flesh breakdown. Stem end cavity is characterized by the formation of a cavity in the proximal area of the fruit resulting from the deterioration of vascular tissues. The area of affected tissue is mainly between the proximal end of the stone and the fruit peduncle and tissues between the stone and the mesocarp. The affected tissues turn brownish in colour at an early stage and then a small cavity develops. The cavity later enlarges as the disorder progresses. The interior of the mesocarp turns yellow or orange, whereas the exterior of the mesocarp remains whitish or pale yellow. SEC may also affect the interior mesocarp entirely or partially.

Causative Factors: The main cause of SEC may be calcium deficiency and accumulation of tannins at the proximal end of the fruit.

Management Strategy: Applying calcium to soil in the form of gypsum @2–4 kg per tree prior to flowering reduces the severity of internal fruit disorder and stem end cavity in 'Kensington Pride' mango.

Jelly Seed

Jelly seed is considered to be the ultimate stage of SEC and has been included among the symptoms of flesh breakdown along with soft nose. The time of occurrence of the first symptom of jelly seed is similar to SEC and early symptoms of jelly seed are observed in both immature and mature fruits. It may affect a large portion of the mesocarp in the advanced stage. Studies at IIHR, Hessarghatta on Amrapali fruits harvested at different maturity levels revealed that the incidence of this disorder increased with fruit maturity. The rate of incidence was found to range from 21 to 68% in fruits harvested at 90% maturity. Fruits harvested earlier showed lower incidence (0-15%).

Symptoms: Jelly seed affects the interior of the mesocarp and is characterized by a more pronounced yellow colour in the affected area as compared to the rest of the mesocarp, which remains whitish or pale green in young fruit. As the symptoms develop, the yellow colour intensifies and reaches a larger portion of the mesocarp. The affected pulp around the stone, eventually becomes brown, softens and may be completely disintegrated to the

point of having the consistency of jelly, all around the endocarp. The affected fruits emit bad odour when cut. Jelly seed affects only the interior of the mesocarp.

Causative Factors: Calcium deficiency is a major cause of jelly seed, which is aggravated by the presence of high nitrogen levels. Occurrence of jelly seed is less in calcareous (limestone) soils but common in acid sandy soils with low calcium content.

Management Strategy: Application of dolomitic lime @ 8 t/ha/year at the onset of monsoon season reduces jelly seed. Harvesting should not be delayed.

Internal Brown Necrosis

Internal brown necrosis caused significant losses to orchardists in Lucknow, Malihabad and other parts of Uttar Pradesh, India. This disorder is now known as 'Internal Necrosis' (IN).

Symptoms: It is characterized by browning of the fruit pulp while they are still on the tree and the affected fruits drop down before reaching maturity. In this disorder, small isolated water soaked grayish areas appear in the lower half of the fruit. Brown spots develop, followed by the formation of dark brown necrotic areas on the fruits which delimit green pans with indefinite outline. Later on, the brown tissues turn into brownish black necrotic lesion, which extend towards the pericarp. These necrotic areas exude gummy substances, developing stones turn brown and longitudinal cracks appear in the fruits. Affected fruits drop down and do not ripen during storage.

Causative Factors: The incidence of IN is more prominent in sandy soils, boron deficient soils and it varies from cultivar to cultivar. For instance cv. 'Langra' is free from this disorder.

Management Strategy: Application of borax @ 500g/tree or foliar sprays (0.5%) at marble stage is very effective in controlling this disorder.

Leaf Scorching

Symptoms: The characteristic symptom is akin to that of potash deficiency i.e. scorching of old leaves at the tips or margins. Affected leaves eventually fall down leading to a reduction in tree vigour and fruit yield.

Causative Factors: It is mainly attributed to excessive chloride in the soil or irrigation water which renders potassium unavailable resulting in potash deficiency in the leaves.

Management Strategy: It can be corrected by spraying potassium sulphate (5%) on young leaves of each new flush. Besides, affected leaves should be collected and burnt. Under such conditions, it would be advisable to use potassium sulphate instead of muriate of potash.

Fruit Cracking

In the past few years, incidences of fruit cracking have been observed and reported from different parts of the country. It is observed in mature fruits rendering them unmarketable. Fruit cracking appears to be a varietal character. Higher incidence of fruit cracking was noticed in Dashehari cultivar from the plains of North India.

Symptoms: In this disorder, fruits crack while still on the tree. Clean and knife like incisions appear on the fruit which run deep. The cracks become brown and dried out. At times, sap may ooze from such cracks. Secondary infections by fungal pathogens (*Colletotrichum gloeosporioides*) may follow cracking. In 2012, mango growers in Dinajpur district of Bangladesh observed black spots on mature fruits. Cracks appeared in infected fruits within 6-10 days of infection.

Causative Factors: Fruit cracking is primarily associated with moisture imbalances and micronutrient deficiencies. It usually occurs when trees are heavily irrigated after a prolonged dry spell or if heavy rains are intermixed with dry spells. Almost all the fruits on the tree are affected. However, those closer to maturity are the most susceptible. The incidence of fruit cracking appears to be higher in fibreless cultivars. Internal necrosis may also lead to fruit cracking in mango. Internal necrosis aggravated the incidence of fruit cracking in Dashehari cultivar. Another cause of fruit cracking is infection by bacterial black spot disease (*Xanthomonas campestris*). Boron

deficiency has also been implicated in this disorder.

Management Strategy: The management strategy for fruit cracking involves regular watering during the fruit maturation stage, mulching to conserve soil moisture, addition of organic manures in the soil to replenish its fertility and application of micronutrients. Foliar sprays of boron were found effective in reducing fruit cracking. Prevention of internal necrosis and bacterial black spot can also reduce the incidence of fruit cracking in mango. Trees should also be protected against strong and desiccating dry winds.

Physiological disorders in mango pose a serious threat to the profitability of any orchard. Growing improved cultivars free from such maladies, use of good quality planting material purchased from certified nurseries, proper orchard management and regular cultural operations can reduce the incidence of these disorders. Of particular importance is planting of wind breaks, proper training and pruning of orchards, integrated nutrient management, mulching, frequent irrigation and timely plant protection measures. Rejuvenation of old orchards, top working with improved varieties, use of plant growth regulators, application of micronutrients as and when required and provision of pollinizers in mango orchards can also resolve these disorders to a great extent.