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Agricultural scenario and challenges in India

India is vast country with about seventy percent of the population lives in villages. The welfare of the country can not progress as long as our villages remain backward. Agriculture and allied field holds backbone of the rural India. Agriculture and allied sectors like forestry, logging and fishing accounted for 17% of the GDP in 2012. For 2013-14, the Central Statistics Office has projected a growth rate of 4.6 percent in agriculture and allied sectors, up from 1.4 percent a year earlier.

Agroforestry is the traditional system in India. It is recognised as an optimal multifunctional land use system that provides direct benefit to the farmers. It also offers opportunities to harness the use of natural resources for high economic, social and environmental gains. However, the accelerating urbanization is leading to poor management of natural resources, especially arable land, water and biodiversity. Hence eco-friendly land use system should be adopted to minimize the impact of climate change. Furthermore, our country has feed shortage and for increasing supply of green herbage, the conservation of degraded pastureland and development of wasteland should be given more emphasis.

India is the hub of livestock population of 535 millions comprising of 199 million cattle, 105 million buffaloes, 140 million goats, 71 million sheep and 11 million pig. With a total annual milk production of 112.5 MMT and meat production of 43.2 million kgs, it has huge impact on Indian economy.

A majority of the peoples/farmers in the agriculture sector are resource poor. They cannot effort to go at conventional universities for agricultural education. Therefore, open and distance learning system with the help of ICT could help greatly in order to impart timely and cost effective education.

It should be ensure that the food and feed evolved through bio-technological intervention should be screened for food safety standards and must be as safe as food produced through conventional methods. About fifty percent rice area in South Asia is rain fed which is prone to abiotic stress like flooding, drought and/or soil salinity and slow adaptation, low and fragile productivity and poor seed replacement therefore, development of stress tolerant rice verities are key challenges ahead to the agriculture scientist.

Due to lack of scientific knowledge in fish farming, the fish production in the pound of rural areas is not satisfactory. Therefore, integrated Fish-Duck farming could be an alternative source of income and also food nutrients which could increase the production almost by two fold than the traditional system.

Development of cooperatives and contract farming scheme are the key strategies for benefiting from globalization through vertical coordination of small farmers with processors and exporters. This helps small farmers to participate in the production of high value crops like vegetable, flowers, fruits, etc.

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THE VICIOUS CYCLE OF FOOD INFLATION IN INDIA

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Albert Einstein one of the revolutionary scientists and thinkers of the world once said: "We cannot solve problems by using the same kind of thinking we used when we created them." Heeding to these words the solution to food inflation lies in thinking out of the box.

Inflation in general and food price inflation in particular has been a persistent problem in India over the past few years. It has been a major challenge to policy makers, more so during recent years when it has averaged 10 percent during 2008-09 to December 2012. Given that an average household in India still spends almost half of its expenditure on food, and poor around 60 percent (NSSO, 2011), and that poor cannot easily hedge against inflation, high food inflation inflicts a strong 'hidden tax' on the poor.

What is food Inflation?

Food inflation is defined as a consistent rise in the price level of all agricultural food items. It is measured on the wholesale price index (WPI). This rise in price level is neither seasonal nor sudden; it keeps on increasing over a period of time. This is one of the biggest problems faced by the economy today.

Nature of India's Food Inflation

The average annual overall inflation rate, as measured by the wholesale price index (WPI) of all commodities, comes out to be 5.8% for the period between1995-96 through December 2012. The table below gives the retail prices for some of the key agricultural commodities in four Indian metros. Clearly, the prices of all key agricultural commodities have risen sharply. Significant price increase has been observed in commodities like, Onion, Vegetables and Fruits.

Table 1. Food Inflation for Selected Commodities in 2011-12

Sl. No.	Commodities	Inflation (Percentage)
1	Onions	74.15
2	Vegetables	65.39
3	Fruits	15.19
4	Milk	12.16
5	Eggs, Meat and Fish	12.04
6	Rice	02.86
7	Cereals	0.23

Major Causes of Food Inflation

There are several factors responsible for food inflation today. One of the prime reasons for the increase in food prices is the rise in prices of petrol and diesel which is the key input for transportation of agricultural commodities to the processing and consumption population. These have rapidly spiralled up costs of production and distribution of all food items as well as services involved in these activities, at all stages.

The recent spurt in the prices of specific food items, like onions today or earlier in the case of sugar and pulses, is hoarding. Trader

cartels, encouraged by the Government, have a major role to play. Almost certain of inaction, hoarders are creating artificial scarcity and cheating people time and again.

The diffusion of big corporate houses in the food economy, international trade in food items and speculative futures trading in agricultural commodities has weakened the government's capacity to control food prices. The share of corporate retail in food distribution has tripled over the past four years. Trade policies allow big traders to make huge profits through export and import of essential food items like wheat, sugar and onions. On the other hand, the PDS has been weakened considerably through targeting. In most states, the role of the ration shops, state agencies like the NAFED etc. and consumer cooperatives in food distribution, have reduced to a large extent. Therefore, the profit margins of private traders have also increased, reflected in growing gaps between wholesale and retail prices as well as farm gate and wholesale prices.

There are medium and long-term reasons too. Agriculture today is suffering. The agricultural growth is not rapid enough to meet the demands of our ever increasing population. The farming community continues to be in distress, with over 2.5 lakh farmers committing suicide over the past 15 years. State intervention in raising agricultural productivity has been weakened. More attention is being focussed on the role of big agribusinesses and retail giants like Walmart and Monsanto in the name of a 'second green revolution'. That will further marginalize the small and marginal farmers which constitute over 80 per cent of the farming population.

Finally, the cuts in subsidies and price hikes of inputs like diesel and fertiliser are also contributing to food inflation. The deregulation of petrol prices has led to very steep hikes in the recent times.

Measures to Ensure Price Stability in Food Items

It is disturbing to note that the per-hectare agricultural productivity in India is approximately half that of China. This indicates inefficiency and the failure to induce farmers adopt latest technology in order to increase crop production. Steps need to be taken in the near future to ensure minimal food wastage, high crop productivity and increase in irrigated land. If the INR 58,000 crore of food crops is not wasted on an annual basis, India's deficits could be wiped out in less than a decade without any other measures being taken. Another major related issue is the strengthening of the supply chain so as to avoid wastage of perishable products. An expeditious completion of the Agriculture Produce Marketing Committee (APMC) Act reforms in different states through which enough flexibility is imparted to farmers to sell their produce would be a good suggestive measure in this regard. Further, it is important to develop a robust agricultural marketing system through adequate domestic and/or foreign investment - so as to strengthen the back end infrastructure and reduce wastages.

The Government is currently holding a buffer stock of nearly 50 million tonnes of rice and wheat, which is way above the buffer norms. 35 kgs of food grains per month should be supplied through a universalized PDS at Rs. 2 per kg and not limited to the arbitrarily determined BPL families. Moreover, other essential commodities like sugar, pulses and edible oils should be supplied at fixed rates across the country through the PDS. Extension

programmes and assistance to farmers regarding fertilizer and pesticide use and alternate cropping pattern based on soil analysis could be undertaken and intensified The crackdown on hoarders and black marketers could help prevent prices from rising further. This step might not significantly reduce prices but will ensure that prices don't escalate further. In this regard, it is also important to prohibit commodity futures trading in food articles, because such trading facilitates speculation on food prices.

Finally, the costs of agricultural inputs like fuel and fertilisers have to be controlled by the Government. Deregulation of fuel and fertiliser prices will raise agricultural costs and contribute to food inflation. The Government must continue to subsidise fuel and fertiliser and rationalize the taxes on petroleum products. The decision to deregulate petrol prices need to be reversed.

Conclusion

There is a need for a long term solution to combat food inflation. Apart from short term measures, long term solution is increase in agricultural productivity and rising incomes of farmers. To curb the adverse impact of food inflation on the common man, the policy of the government should emphasise on the PDS, foreign trade policy, anti-hoarding measures and strengthening of supply chain efficiency. Besides supporting farmers, Government agencies, cooperatives and self-help groups should be supported to open more outlets to sell food items like vegetables, milk etc. Moreover, The Evergreen Revolution of boosting food-grain output in India to 400 million tonnes in next 15 years is need of the day. It is achievable if the mindset on introducing and embracing newer technology is changed.

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ANTIQUITY OF FLORAL GENE TO UNDERSTAND FLOWER DEVELOPMENT IN PLANTS

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(Plants respond to the changing seasons to initiate developmental programmes precisely during the year. Flowering is the best example of seasonal changes, and in temperate climates it often occurs in spring. Genetic approaches in plants have shown how the underlying responses to changes photoperiod or winter temperature (vernalization) are conferred and how these converge to create a robust seasonal response. Recent advances in plant genome analysis have demonstrated the diversity in these regulatory systems in many plant species, including several crops and perennials, such as poplar trees. Here, we show progress in genetic mechanisms that enable plants to recognize winter, spring and autumn to initiate flower development.)

There are so many predictions about the presence of different gene families for flower induction and development. Scientists have studied the flowering of higher plants for nearly a hundred years. The flowering process is extremely complex. Many studies have shown that the floral development process in plants is controlled not only by the complex regulation of multiple genes in internal factors, but also by a variety of environmental factors (Tan *et al.*, 2006). These genes have very specific role in flower developments. These genes are navigator for flowering process. Photoperiodic control of flowering is also important in agriculture and horticulture. Breeding to extend latitudinal range or altered timing of flowering involves understanding and exploiting variation in the photoperiodic responses of a particular species. Day length manipulation in order to schedule flower production is also a common practice. Many plants show precisely controlled seasonal patterns in flowering. Decades of physiological analyses have dissected such behaviors into responses to discrete environmental cues, such as day length (photoperiod) and winter temperatures (vernalization) (Lang A, 1952). Vernalization has only been studied at the molecular level in a few species and, in all cases, results in the inhibition of a repressor, thereby allowing FLOWERING LOCUS T (FT) to be expressed (Ream *et al.*, 2013). Here we also mentioned about florigen. It is protein encoded by flowering locus T gene in *Arabidopsis thaliana* and its homologus plants .

Genes Controlling Floral Initiation During Photoperiodism

Photoperiodism can be defined as the response to changes in day-length that enables plants to make survival to seasonal changes in their environment. Except at the equator, the passage of the year is marked by a continuous but highly reproducible variation in the length

of the day. In order to locate the time of year accurately, a timekeeping mechanism operates with precision as part of the plant's photoperiodic sensing mechanism in a way that is insensitive to less predictable variations in the environment such as temperature. Photoperiod alone is not an unambiguous signal as any particular daylength occurs twice in an annual cycle. Progressive changes in daylength, which are at their greatest around the equinoxes in spring and autumn, do, however, provide a certain environmental signal for the passage of the seasons (Thomas, 2006). The seasonal range and rate of change of daylength is lower in the tropics than at higher latitudes and photoperiodic mechanisms need to be sufficiently precise and flexible to operate across the entire range of day lengths.

The predominance of the different pathways changes with the developmental state of the plant. Early on in the life cycle of the plant flowering is actively repressed to enable the plant to grow sufficiently large to be able to support the development of flowers, fruits and seeds. As the plant develops this repression is gradually lifted by what have been termed floral-enabling pathways such as the vernalization and autonomous pathways (Boss *et al.*, 2004). Expression of the floral-integrator genes is actively repressed by the floral inhibitor FLOWERING LOCUS C (FLC). Consequently flowering is prevented until this repression is lifted by the floral-enabling pathways, thus allowing activation of the floral-pathway integrators by the floral-promotion pathways. The levels of FLC are maintained at a high level by the FRIGIDA (FRI) gene. The activity of the FRI gene and consequently the resulting levels of FLC are major determinants in flowering time in Arabidopsis. Mutations in the FRI gene are responsible for most of the variation in flowering time observed in different ecotypes of Arabidopsis (Johanson *et al*., 2000). Loss-of-function mutations in the FRI gene are found in early flowering ecotypes of Arabidopsis,

such as Landsberg erecta and Colombia. These mutations result in low FLC levels and only mild repression of the floral-pathway integrators. This low-level repression can be directly overridden by activation of a floral-promotion pathway, e.g. the photoperiodic pathway, without the need for a floral-enabling pathway to first lift the repression by FLC. In addition to FRI other genes are involved in the upregulation of FLC. These include EARLY IN SHORT DAYS 4 (ESD4), PHOTOPERIOD INDEPENDENT FLOWERING 1 (PIE1), EARLY FLOWERING IN SHORT DAYS (EFS) AND VERNALIZATION INDEPENDENCE (VIP) genes. The mechanism of action of these genes is currently poorly understood.

The Circadian Clock and the Central Oscillator

Circadian rhythms (circa means approximately, and dies means day) have been described in a different range of organisms ranging from cyanobacteria to mammals and at every level of organization. These rhythms have the same fundamental properties: (1) their ability to become entrained, or synchronized, to diurnal changes in environmental conditions; (2) persistence upon transfer to constant conditions; and (3) a constant period over the physiological range of temperatures. In plants, the circadian clock

controls expression of approximately 6% of the transcriptome (Harmer *et al*., 2000). This includes genes encoding components of all major metabolic pathways as well as genes involved in hormone biosynthesis, photoreceptors and floral regulators such as CO, FT and GI.

The circadian mechanism of higher plants comprises transcriptional– translational similar to those described earlier for fungal and animal clocks (Young and Kay, 2001). In *Arabidopsis*, the central oscillator comprises three key components named LATE ELONGATED HYPOCOTYL (LHY), CIRCADIAN CLOCK-ASSOCIATED 1 (CCA1) and TIMING OF CAB1 (TOC1). Expression of the LHY and CCA1 mRNA levels oscillates and levels of both transcripts peak shortly after dawn. The LHY and CCA1 proteins also are synthesized rhythmically with a lag of approximately 2 h after their cognate mRNAs. Both transcription factors bind to a promoter element known as the evening element and act to inhibit transcription of evening-specific genes, including TOC1. In the evening, the level of both repressors declines and transcription of the TOC1 gene resumes. Accumulation of the TOC1 protein at night promotes transcription from the LHY and CCA1 promoters, thus initiating a new cycle (Alabadi *et al*., 2001). It is not clear at this point how TOC1 performs this function as the TOC1 protein does not comprise a DNA-binding domain and does not exhibit features typical of any transcription-factor family. The TOC1 protein comprises an N-terminal domain similar to response-regulator proteins of plant and bacterial two-component signalling systems, but lacks an aspartate residue that is required for phosphotransfer (Makino *et al*., 2002; Strayer *et al*., 2000). Another domain known as the CCT-domain is thought to play a role in protein–protein interactions since in yeast it mediated binding of CO and TOC1 to the transcriptional regulator ABI3 (Kurup *et al*., 2000). TOC1 may regulate transcription through its interaction with ABI3. It has also been shown to interact with a number of basic helixloop- helix (bHLH) transcription factors including the phytochrome-interacting protein PIF3 (Makino *et al*., 2002; Yamashino *et al*., 2003). This is interesting because PIF3 binds a G-box motif (CCACTG?) within the promoters of the LHY and CCA1 genes (Martinez-Garcia *et al*., 2000). TOC1 may therefore regulate expression of the LHY and CCA1 mRNAs by modulating the activity of a light-responsive transcription factor, thus placing the oscillator very close to light-response mechanisms.

Vernalization

Distinct aspects of temperature contribute to flowering time control. The vernalization pathway controls flowering of winter-annual Arabidopsis accessions in response to prolonged periods of cold by the epigenetic silencing of the potent floral repressor FLOWERING LOCUS C (FLC). The repression of FLC homologues during vernalization has also been described in other members of the Brassicaceae (Wang *et al*., 2009). However, more distantly related species from different plant families appear to use distinct regulatory mechanisms to confer vernalization requirement, suggesting that these have arisen by convergent evolution. In temperate crops, such as the cereals wheat and barley, vernalization requirement is an

important agronomic trait used to extend the period of growth of crops, increasing the size of the plant and seed yields. In this way, varieties that require vernalization to flower can be sown late in summer and will not flower until spring or early summer the following year. Such vernalization-requiring varieties carry active alleles of genes that delay flowering until vernalization has occurred, and this is analogous to the effect of *FRI* and *FLC* in *A. thaliana*.

In vernalization-requiring varieties of temperate cereals, the promotion of flowering by long days is blocked until they have been exposed to winter temperatures. The interaction between the photoperiod responses and vernalization is mediated by VRN2, which is not found in *A. thaliana*. Under long days, VRN2 blocks the expression of at least one of the *FT* genes found in cereals (Dubcovsky *et al*.,2006). Its transcription is repressed after exposure to vernalization by the MADS box transcription factor *VERNALIZATION 1* (*VRN1*) that is expressed in response to vernalization exposure. *VRN2* expression is also repressed by a short-day-mediated repression by a mechanism that is still unclear (Trevaskis *et al*.,2006)

The Florigen

The flower hormone concept was given by Julius Sachs (1865) From his well-known experiments with partially darkened *Tropaeolum majus* and *Ipomoea purpurea* plants, he concluded that leaves in the light produce flowerforming substances in very small amounts, which direct the assimilates to form flowers in darkened shoots. However, more convincing evidence in support of flower-forming substances did not appear until after the discovery of photoperiodism, the response of plants to the relative length of day and night (Garner and Allard, 1920). A role for FT and/or FT mRNA as the phloem-mobile florigenic signaling agent(s) was tested using a range of tissue-specific promoters. In contrast with CO, FT promoted flowering not only when it was expressed in source companion cells, but also in numerous other tissues, including those of the meristem, a tissue in which it is not normally detected by in situ hybridization (An *et al*., 2004).Given that FT expression is controlled by CO (Samach *et al*., 2000) and is required to promote flowering (Kobayashi *et al*., 1999), these results strongly implicated FT as a component of the florigenic signaling system.

Conclusion

Genetic and molecular studies, largely with the model plants over the last decade have gone a long way to confirm and explain the essential elements of flowering in plants. Some of the evidence that genes encoding FT-like proteins play a key role in controlling flower development. Roles of FT-like genes and florigen in the seasonal control of flowering is much essential. The physiology of photoperiodic mechanisms involved multiple interactions between photoreceptors and an underlying circadian rhythm in light sensitivity through an external-coincidence model have been borne out. This understanding will be of great benefits to biotechnologist in designing and growing plants with flowering properties tailored to the food and ornamental industries and the wider needs of society.

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ANTIOXIDANTS AND ITS BENEFICIAL ROLE IN ANIMAL HEALTH

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Antioxidants are a group of substances which even at low concentration significantly inhibit or delay oxidative processes. Oxidation is a chemical reaction that transfers electrons from a substance to an oxidizing agent. Antioxidants act as "free radical scavengers" and hence prevent and repair damage done by these free radicals. Health problems such as heart disease, macular degeneration, diabetes, cancer etc. are all contributed by oxidative damage. Antioxidants enhance immune defense and therefore lower the risk of cancer and other infections. Thus antioxidants can be used as ingredients in dietary supplements in the hope of maintaining health and boosting up immune status of animals. In recent years there has been an increased interest in the application of antioxidants to medical treatment as research is showing linking of diseases to oxidative stress. Residual level of antioxidants in animal by–products like milk, meat and egg is another emerging field of livestock nutrition as antioxidant enrichment of food products is currently receiving much public attention with respect to their potential to promote better health.

History

In past, the term "antioxidant" was used to refer specifically to a chemical that prevented the consumption of oxygen. Use of antioxidant begins with extensive study in important industrial processes, such as the prevention of metal corrosion, the vulcanization of rubber, and the polymerization of fuels in the fouling of internal combustion engines. Role of antioxidant in biological systems begins with their use in preventing the oxidation of unsaturated fats, which is the cause of rancidity (German, 1999). The possible mechanisms of action of antioxidants were first explored when it was recognized that a substance with anti-oxidative activity is likely to be one that is itself readily oxidized. Research into how vitamin E prevents the process of lipid peroxidation led to the identification of antioxidants as reducing agents that prevent oxidative reactions, often by scavenging reactive oxygen species before they can damage cells (Wolf, 2005).

Functional antioxidant system in the body

Body reacts to oxidative stress through complex mechanism of action

interlinked to each other comprise of different enzymes, low molecular weight proteins, high molecular weight proteins as,

1. Enzymes

Their function in body is to prevent generation of reactive oxygen species, removal of potential antioxidants or transfer of reactive oxygen or nitrogen species into relatively stable compound, e.g. superoxide dismutase (SOD), catalase, and glutathione peroxidase

2. High Molecular Weight Proteins

These high molecular weight proteins present in plasma, bind to redox active metals and limit the production of metal-catalyzed free radicals e.g. albumin, ceruloplasmin, transferrin and haptoglobin (Halliwell and Gutteridge,1990). Albumin and ceruloplasmin can bind copper ions, and transferrin binds free iron. Haptoglobin binds heme-containing proteins and can thus clear them from the circulation.

3. *Low Molecular Weight Antioxidants*

These proteins are subdivided into lipid-soluble antioxidants (tocopherol, carotenoids, quinones, bilirubin and some polyphenols) and water-soluble antioxidants (ascorbic acid, uric acid and some polyphenols). They delay or inhibit cellular damage mainly through their free radical scavenging property.

Sl No.	Component Related	nutrient	Function
1.	SOD (cytosol)	Cu, Zn	Converts superoxide ions to peroxides
2.	SOD (mitochondria)	Mn, Zn	Converts superoxide ions to peroxides
3.	Ceruloplasmin (liver/ blood)	Cu	Prevents Cu from participating in oxidation reactions
4.	Ferritin (liver/ blood)	Fe	Prevents Fe from participating in oxidation reactions
5.	Glutathione peroxidase (cytosol)	Se	Converts peroxide to water
6.	Glutathione (cytosol)	S	Neutralizes free radicals
7.	Catalase (cytosol)	Fe	Converts peroxide to water
8.	tocopherol(cell membrane)	Vitamin E	Scavenges free radicals
9.	Carotenoids (cell membrane)	carotene	Breaks peroxidation chain reactions
10.	Ascorbic acid (cytosol)	Vitamin C	Breaks peroxidation chain reactions and scavenges free radicals

(Weiss, 2005)

Mechanisms of Antioxidant Functions

Antioxidants system in the body works via various mechanisms including:

1. Preventive antioxidants – suppress formation of free radicals e.g. catalase (Fe containing) and glutathione peroxidase (Se containing), two antioxidant enzymes, decompose hydrogen peroxide, preventing the formation of oxygen radicals.

2. Free radical scavengers - confer stability to the 'reactive' species by donating an electron and become oxidized themselves to form a more stable radical e.g. alpha-tocopherol (vitamin E) scavenges peroxyl radicals and is converted to a tocopherol radical. Illustrating antioxidant interactions, the vitamin E becomes "re-activated" by ascorbic acid donating an electron which in turn forms an ascorbate radical in the process.

3. Sequestration of metal by chelation - Although trace minerals are important dietary constituents, they can act as pro-oxidants (promote free radical formation). Since trace minerals such as Fe and Cu can propagate the formation of more reactive radicals they are kept bound to transport proteins such as transferrin or ceruloplasmin, rendering them less available to contribute to radical or pro-oxidant formation.

4. Quenching of active oxygen species - Antioxidants can convert active oxygen species to more stable forms; for example, carotenoids and vitamin E stabilize singlet oxygen radicals, forming less reactive hydrogen peroxide.

Animal Studies of Antioxidants:

Vitamin C protective effect may partly be mediated through its ability to reduce circulating glucocorticoids. The suppressive effect of corticoids on neutrophil function in cattle has been alleviated with vitamin C supplementation. Vitamin C and E supplementation resulted in a 78% decrease in the susceptibility of lipoproteins to mononuclear cell-mediated oxidation (Rifici and Khachadurian, 1993).

Supplementation of vitamin E and Se have been shown to provide protection against infection by several types of pathogenic organisms, as well as improve antibody titers and phagocytosis of pathogens. For example, calves receiving 125 IU of vitamin E daily were able to maximize their immune responses compared to calves receiving low dietary vitamin E (Reddy *et al*., 1987). Supplemental vitamin E may enhance recovery from bovine respiratory disease. Antioxidants, including vitamin E, play a role in resistance to viral infection. Vitamin E and Se deficiency allows many viral diseases in animals by changing the viral phenotype, such that an avirulent strain of a virus becomes virulent and a virulent strain becomes more virulent (Beck, 1997). Supplementing vitamin E at higher than recommended levels (Dairy cattle NRC, 2001) has improved control of mastitis. Smith and Conrad (1987) reported that intramammary infection was reduced 42.2% in vitamin E-Se supplemented versus unsupplemented controls. The duration of all intramammary infections in lactation was

reduced 40 to 50% in supplemented heifers. A known consequence of vitamin E and Se deficiency is impaired PMN activity. Further, postpartum vitamin E deficiencies are frequently observed in dairy cows. Dietary supplementation of cows with Se and vitamin E results in a more rapid PMN influx into milk which cause intramammary bacterial damage and increased intracellular kill of ingested bacteria. Subcutaneous injections of vitamin E approximately 10 and 5 d before calving successfully elevated PMN alpha-tocopherol concentrations during the periparturient period. Currently, it is suggested that peripartum dairy cows receive 2,000 to 4,000 IU vitamin E/d for optimal udder health (Seymour, 2001).

Carotenoids have been shown to have biological actions independent of vitamin A. Recent animal studies indicate that certain antioxidant carotenoids which lack vitamin A activity, can enhance immune function, act directly as antimutagens and anticarcinogens, protect against radiation damage, and block the damaging effects of photosensitizers. Also, carotenoids can directly affect gene expression which may enable carotenoids to modulate the interaction between B cells and T cells, thus regulating humoral and cell-mediated immunity (Koutsos, 2003). Vitamin A and beta-carotene have important roles in protection against numerous infections including mastitis. Beta-carotene supplementation appears to stabilize PMN and lymphocyte function, both key components in defense against infection, during the period around dry off. Beta-carotene enhanced the bactericidal activity of blood and milk PMN against *S. aureus* but did not affect phagocytosis. Control of free radicals is important for bactericidal activity but not for phagocytosis. The antioxidant activity of vitamin A is negligible; it does not quench or remove free radicals. Beta-carotene, on the other hand, does have significant antioxidant properties and effectively quenches singlet oxygen free radicals (Mascio *et al*., 1991).

Conclusion

The antioxidant studies suggest that a wide range of natural and synthetic compounds possess antioxidant property. Most studies evaluating antioxidant properties have been conducted for short period under *in vitro* conditions. There is a need to determine the suitability of these products for *in vivo* application in terms of effective level of supplementation, interaction with other feed components, and effect on other biochemical parameters by taking some long term trials. Residual level of antioxidants in animal by–products like milk, meat and egg is another emerging field of livestock nutrition as antioxidant enrichment of food products as "Designer foods" is currently receiving much public attention with respect to their potential to promote better health.

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CONGENITAL DEFECTS IN CATTLE

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Congenital is a descriptive term denoting a condition existing at birth; hence congenital malformations or congenital deformities are defined as abnormalities of structure present at birth. Developmental or congenital abnormalities, defects and anomalies, include functional as well as morphological imperfections. Abnormal phenotypes are products of the genetic constitution of an animal and the molecular, cellular, and histogenic environment in which they grow (Colin, 1988).There are many undesirable traits that show up in cattle. These range from poor performance and structural unsoundness to semi-lethal and lethal diseases. Congenital defects are present in all breeds of cattle. In most herds, they are rather uncommon; however, occasionally the frequency within a herd will be high enough to be of considerable economic importance.

Causes

The cause of many congenital defects is unknown, but some are inherited. Inherited disorders in cattle are mostly caused by autosomal recessively inherited genes.It is characteristic that the action of autosomal recessive genes only becomes expressed as a diseased phenotype if present in both loci. Therefore, autosomal recessively inherited disorders are of greater concern in cattle breeding than are disorders with dominant inheritance or recessive X-linked inheritance. As dominant or recessive X-linked genes are expressed in the phenotype of males, sires carrying such genes are mostly omitted from breeding. However, if the defective allele produces a desirable phenotype in heterozygous individuals, such animals may be used for breeding (Jorgen, 2007).

Included in the list of recognized environmental causes are maternal nutritional deficiencies, teratogenic drugs or chemical exposure, mechanical interferences with the fetus, some viral infections, toxic plant, radiology, rectal palpation for gestation diagnosis and toxic effects of any kind that dam would be exposed to during the early stage of organogenesis (Rafid, 2010).

Congenital Defects

Though there are many congenital and inherited defects reported in cattle but some of the most commonly occurred are discussed below:

l. Dwarfism: There are several types of dwarfism caused by both environment and genetics.

- **Snorter dwarfism**. Animals are short and compact at birth. The fore limbs are abnormally short, head may be overly square, lower jaw slightly protruding and frequently a bulging or prominent forehead. The tip of the tongue usually protrudes and the eyes are bulging. Inherited as a simple recessive trait (Figure 1).
- **Long head dwarfism** causes small size but does not affect the bone growth in nasal passages. Inherited as a simple recessive trait.
- **Compress dwarfism** is inherited as incomplete dominance. An individual with one compress gene and one normal gene

has an extremely compressed body conformation. The individual with two compress genes is a dwarf and the calf dies at or soon after birth. Animals appear to be almost normal but head, body, neck and legs are slightly shorter than in normal animals.

Its mode of inheritance was determined by the early 1950s (Baker et al., 1951, Pahnish et al., 1955) and the investigators set about identifying the source, the reason for its prevalence.

2.Water head (internal hydrocephalus): Excess fluid is present in the brain. Calves are usually born dead or die shortly after birth. Environmental factors can cause the disease, as well as being inherited as a simple recessive trait.

3.Marble bone (osteopetrosis)*:* Calves born prematurely (10-30 days premature).Typically calves are born dead, but if born alive will die within 24 hours after birth. Calves possess a short lower jaw and impacted molars. Long bones are fragile and can be broken with ease (Figure 2). Inherited as a simple recessive trait.

4.Hairlessness (hypotrichosis)*:* Abnormal hair development, resulting in a less than normal amount of hair. Occasional the hairless lesions may occur in multiple sites, however most commonly the disease is generalized, and the entire skin is affected. Inherited as a simple recessive trait.

5. Rigid joints (arthrogryposis): Affected calves are born at term but most calves are stillborn or die shortly after birth, probably due to respiratory failure. Live born calves have muscular hypotonia. Flexion of the forelimbs, particularly due to flexion of the metacarpophalangeal joints and the carpus, rotation of the digits, and hyperextension of the metatarsophalangeal joints are found, but most joints of the appendicular skeleton may show flexion or extension (Jorgen, 2007).

6. Extra toes (polydactyly)*:* One or both front feet are usually affected, but all four may have the outer dew claw develop into an extra toe. At least two sets of genes are involved in the inheritance of this trait.

7. Mulefoot (syndactyly)*:* The two toes are fused together to produce only one toe. The front feet are most often affected, but all four may be affected (Johansson et al., 2006). Inherited as a simple recessive trait (Figure 3).

8.Weaver calf (progressive bovine myeloencephalopathy)*:* The disease occurs between six months and two years old and occasionally later. The main clinical signs are ataxia, progressive weakness of the pelvic limbs, difficulties to stand up, proprioceptive deficit and oscillatory hypermetric walking.The mental state is always alert and all the reflexes are always present and normal. Inherited as a simple recessive trait.

9. Photosensitivity (protoporphyria)*:* Animals are sensitive to sunlight and develop scabs and open sores when exposed to sunlight (Figure 4). The liver is also affected and the animals may suffer from seizures (Haydon, 1975). Inherited as a simple recessive trait.

10. Bulldog (achondroplasia)*:* This trait is inherited as an incomplete dominant. The homozygous may be aborted dead at 6-8 months gestation and has a compressed skull, nose divided by furrows and shortened upper jaw, giving the bulldog facial appearance. The heterozygous calf is small and heavy-muscled.

11. Double muscling*:* It is the result of a defect in the myostatin gene, which is responsible for regulating the growth of muscle fibers during development. Without a functioning mysostatin gene, muscles will develop hypertrophy (increase in muscle fiber size) and hyperplasia (increase in number of muscle fibers), resulting in the appearance of a "double muscled" animal (Figure 5).Inherited as a simple recessive trait.

12. Parrot mouth (brachygnathia inferior): One type of parrot mouth (Figure 6) is inherited as a simple recessive trait. The more common cause of teeth and denture pads not meeting is a quantitative trait caused by

several sets of genes. This can cause either an under or over shot jaw with varying degrees of expression.

13. Cryptorchidism: One or both testicles fail to descend into the scrotum. Inherited as a sex limited trait and probably involves at least two sets of genes.

14. Prolonged gestation*:* The fetus fails to trigger parturition. Parturition must be induced or the calf removed. The calf is often extremely large and often dies.

15. White eyes (Oculocutaneous Hypopigmentation): Hair coat is a bleached color and the iris is pale blue around the pupil with tan periphery.

Figure 1. Dwarfism (snorter dwarf).

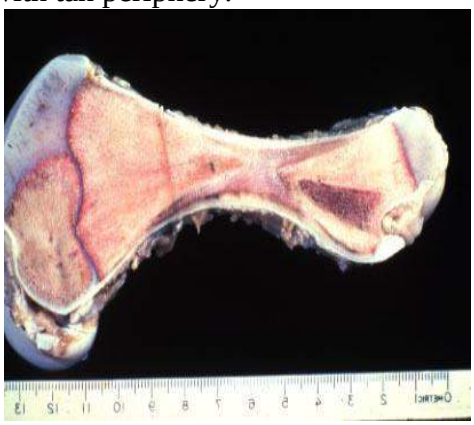

Figure 2. Marble bone (osteopetrosis).

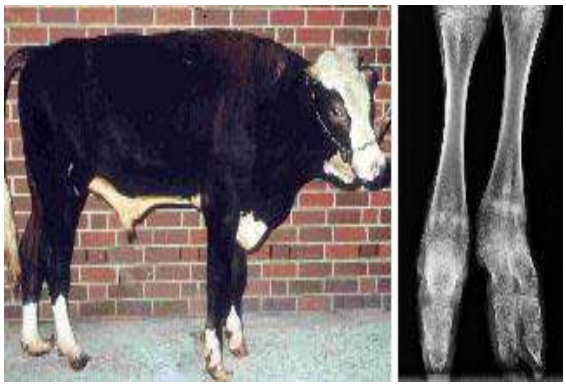

Figure 3.Mulefoot (syndactyly).

Figure 4. Photosensitivity (protoporphyria).

Figure 5. Double muscle.

Figure 6. Parrot mouth (brachygnathia inferior).

Importance of Abnormal Development

The obvious impact of abnormal development is loss of the nonviable fetus. This presents two possible problems for the producer: first, financial loss, through loss of saleable animals and the cost of retaining the dam for another year, in the case of cattle; second, this abnormal fetus may herald an outbreak of similarly affected fetuses if the whole herd has been affected by an environmental teratogen or if an abnormal gene has entered the gene pool of the herd.

Conclusions

The best control of genetic diseases is to avoid animals that carry these genes. Bulls or semen should be purchased from reputable breeders, produced by parents who are not known to carry undesirable genes. The elite purebred breeder or owner of Al bulls may wish to test for simply inherited traits before bulls or donor cows are heavily used. If the undesirable trait is dominant, no test is needed since the animal would show the trait even if only one dominant gene is present. Testing is usually useful only when the trait is inherited as a simple recessive trait. Carriers should be identified and prevented from producing calves which may be used for breeding purposes. Since mutations occur in every generation, genetic defects can never be completely eradicated. However, modern genetic technology can greatly speed up the process of identifying which cattle are carriers and provide techniques for elimination of the defective genes from the breeds.

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ANIMAL GENETIC RESOURCES AND INTELLECTUAL PROPERTY RIGHTS (IPRs)

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Herdsmen have practiced the art of animal breeding since the beginning of domestication of livestock. From its roots in mendelian inheritance to developments in modern quantitative genetics the field has grown and enlarged its base to include modern molecular genetics. The practical applications have been to genetically improve animals that produce meat, milk and other products of economic value. The advent of molecular biology, sequencing of genomes and development of cloning have brought large amount of money. These developments are anticipated to be applicable to the genetic improvements of animals. However, more emphasis is required to drive research, which in turn needs to yield value, Patents, primarily associated with chemistry, physics are now being utilized in field of animal genetics to protect the intellcectual property that is developed.

Different forms of Intellectual property

Intellectual Property (IP) is a category of property that confers rights over intangible creations of human intellect. Intellectual Property rights as a collective term includes patents, trademarks, geographical indications, trade secrets and copyright. IPR are largely territorial in nature except copyright, which is global in nature. At the international level, Convention on Biological Diversity (CBD) of United Nations and Trade Related Aspects of Intellectual Property (TRIPs) Agreement of World Trade Organization are the two major agreements governing access and rights over genetic resources. As India is signatory to both CBD and TRIPs, there is a need to assess the issues at hand with a global perspective and also narrate and evaluate the options for the typical livestock production situation existing in the country. There are various types of IPRs. Very few are relevant to the livestock sector which include patents, trademarks, trade secrets and geographical indications. Each of these forms of IPR has different requirements and grants different legal status.

Patents

A patent is a set of exclusive rights granted by a sovereign state to an inventor for a limited period of time in exchange for detailed public disclosure of an invention Patents grant an exclusive right to prohibit others from using an invention for commercial purposes. Patents are given to the invention which fulfils the criteria as:

- Should be new compared with what was previously known
- Should involving an inventive or non-obvious step
- Should be capable of industrial application.

Patents are “territorial rights” and only granted and effective in the countries that they have been applied for. So if a patent has

been granted in India, then the invention is patent-protected only in that country and not elsewhere. Basically, each country has its own national patent law in which it defines what can be patented and what not. In Europe there is only one institution dealing with patent applications, the European Patent Office (EPO) in Munich. The patents granted by the European Patent Office are called European patents. However, World Intellectual Property Organization (WIPO) accepts applications for patents that it then forwards to all other countries. WIPO is also seeking to harmonize patent law worldwide by establishing a substantive patent treaty that will be globally effective.

Patenting in livestock sector

The idea of an animal patent exploded in 1988 when the Patent and Trademark Office (PTO) issued its first animal patent to the transgenic mouse known as the "Harvard Mouse"(Woessner, 2001). However, no clear policy was ever articulated regarding animal patents. Rather, the PTO accepted transgenic animals as patentable subject matter, essentially, by default (Michael, 1993).

In the livestock sector, patents have been granted for gene sequences in connection with genetic markers. A New Zealand company, Agmark, has claimed a patent on the "Booroola" gene, which regulates the ovulation rate in sheep. The patent covers animals that are produced in a breeding programme in which the DNA test has been used, but not those animals that carry the gene naturally. However, the open question is whether the patent also covers the offspring of the animals that have been tested for the presence of the gene. Another notable patent application is one by Monsanto for a series of twelve patents on pig breeding. It is currently pending at WIPO. The rationale of patents is that they should provide incentives for innovation, research and development. However, the challenge ahead is whether they would really fulfil this purpose in the animal breeding sector and inhibit use of animal genetic resources by researchers, breeders and farmers.

Trademarks

Trademarks are distinctive signs, such as symbols, letter, shapes or names that identify the producer of a product and protect its associated reputation. They are an asset and as such may be licenced by the owner of the trade mark. Well known example include the Coca-Cola lettering, McDonald's "golden arches" etc. A specific type of product from a specific breed can be trademarked but not genetic material. Examples include "Berkshire Gold" and "Certified Angus Beef".

Trade secrets

They consist of commercially valuable information that is kept secret from competitors. As long as they remain secret, trade secrets are protected by laws which prevent acquisition by commercially unfair means and unauthorized disclosure.

Trade secrets do not establish an exclusive right over a genetic resource, but have been used with great success by genetics companies in the poultry sector and in hybrid pig breeding. These companies go to great length to keep their nucleus stock and information about pedigrees out of reach of competitors. Examples include selection indexes used by breeding companies

Geographical Indications

Geographical indications identify the specific area of origin of a product, and the associated qualities, production process, reputation, and other characteristics. They do not protect the genetic resource, but can

add value to products of a particular breed in a particular region. Examples include Karoo lamb (South Africa) and Chos Malal goat meat (Argentina). There is strong evidence from both developed and developing countries that origin-based marketing in which control over production processes remains with the livestock keepers can empower them versus corporate interests and provide greater earning power.

Sui Generis System

The term sui generis is used in the TRIPS Agreement in connection with the protection of plant varieties. It means that an IPR law of its own kind adapted to the specific needs of the crop sector can be developed as alternative. In spite of significant contribution of animals to the food security and nutrition, laws and policies including intellectual property protection on genetic resources at the national as well as international level should be strengthen. There is a need for legally binding internationally accepted system for access and sharing of benefits from the use of Animal Genetic Resources (AnGR) and associated traditional knowledge and recognition of community rights over knowledge and biodiversity. Considering the special characteristics of AnGR it is essential to develop a suitable sui generi system for AnGR for protection of intellectual property rights (Ramesha *et al.*, 2007).

Livestock Keepers' Rights

- The concept of Livestock Keepers' Rights has been developed over a period of almost seven years in a series of livestock keepers' and pastoralists' meetings on three continents. The cornerstones of this concept include:
- Recognition of livestock keepers as creators of breeds and custodians of animal genetic resources.
- Recognition of traditional breeds as collective property, products of indigenous knowledge and cultural expression.
- The right of the livestock keepers to make breeding decisions.
- Right of livestock keepers to participate in policy making processes on issues relating to animal genetic resources.
- Support for training and capacity building of livestock keepers in the provision of services along the food chain.
- Some governments, including India support the concept of Livestock Keepers' Rights, but other governments regard them as unexplored legal or political ideas.
- Some experts believe that Livestock Keepers' Rights could conflict with patents on genes.

Current issues of concern

The continued availability of animal genetic resources for the purpose of sustainable agricultural production is a matter of concern for both developing and developed countries. Coupled with this concern are the issues of the conservation of the locally adapted breed populations developed by agriculturalists, the continued access to and sharing of the benefits derived from these resources, the importance of Livestock Keepers' Rights and the implications of intellectual property rights protection in various forms of these resourcesAs an adjunct to these issues is the use and protection of transgenic animals for the purposes of modeling human diseases and the production of human

pharmaceuticals for commercial purposes (Woessner, 2001) .

Conclusion

We may conclude that the full scope of patent protection in the field of animal breeding has not yet been determined. The effects of IPRs on animal genetic resources on genetic diversity, genetic improvement and the livelihoods of livestock keepers have scarcely been analysed, but are in urgent need of exploration. The customary right of livestock keepers to breed their animals, which has been the driver of livestock biodiversity, may be under threat unless specific national and international legal frameworks were developed. For example, are patents likely to promote or stifle breeding, research, and development in the animal sector? What distributive effects will these changes in patent law and patent practice have among farmers, livestock keepers, breeders and multinational breeding companies? More knowledge about the effects of patents in this field of technology would help to provide the courts and other decision-makers with a better foundation for deciding on questions concerning the scope of patent protection in this field of agriculture and innovation.

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APPLICATION OF BIOTECHNOLOGICAL TOOLS TO ANIMAL BREEDING

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Science and technology have made a major contribution to the transformation of agriculture both crop and animal. Most of the technological gains have been realized in the developed countries. The impact of most technological progress has, unfortunately, been more limited in developing countries. As a result, smallholder crop-livestock systems which support the large majority of the poor have remained much more reliant on the locally available knowledge and production techniques. Therefore, to address the emerging challenges posed by the rapidly growing human population and urbanization there is a need for the adoption and the use of advances in science and technology. This will enable smallholder systems to respond to the changing social, economic and environmental challenges. Recent advances in animal breeding, molecular biology, reproductive technologies and information and communication technologies, present unprecedented opportunities for livestock improvement in the developing countries.

Reproductive biotechnologies

Artificial insemination (AI), embryo transfer (ET) and semen sexing are some examples of reproductive biotechnologies. AI is the process of collecting sperm cells from a male animal and manually depositing them into the reproductive tract of a female. AI is the first reproductive technique that had a major impact on animal breeding schemes worldwide. In combination with pedigree registration and milk recording, AI offers the opportunity to obtain accurate estimates of breeding values of young bulls and results in a genetic progress that is much higher than natural mating. This is due to the high selection intensity and accuracy arising from AI since only the top bulls are selected for use in producing numerous offspring in many herds.

The main advantages of AI include increased efficiency of bull usage. This means the use of AI enables the production of a very large number of offspring from a single elite sire. Hence, it makes the maximum use of superior sires possible. For instance, natural service would probably limit the use of one bull to less than 100 matings per year. AI usage enabled one dairy sire to provide semen for more than 60.000 services. Moreover, AI reduces the danger of spreading infectious genital diseases. Time required to establish a reliable proof on young bulls is reduced through the use of AI. Other advantages include early detection of infertile bulls, use of

old or crippled bulls and elimination of the dangers of handling unruly bulls.

There are also a few disadvantages of AI, which can be overcome through proper management. A human detection of heat is required and thus the success or failure of AI depends on how well this task is performed. AI requires more labor, facilities and managerial skills than natural service. Proper implementation of AI requires special training, skill and practice. Utilization of few sires, as occurs with AI, can reduce the genetic base. Thus the AI industry and animal breeders should make every effort to sample as many young sires as possible.

Artificial insemination is recognized as the best biotechnological technique for increasing reproductive capacity and it has received widespread application in large farm animals. It is widely used in most countries and the demand is growing.

Embryo transfer is a hormonal manipulation of the reproductive cycle of the cow, inducing multiple ovulations, coupled with AI, embryo collection, and embryo transfer to obtain multiple offspring from genetically superior females, by transferring their embryos into recipients of lesser genetic merit. The high genetic merit embryos can be frozen for later transfer or sale. Most dairy farmers who use embryo transfer simply want more heifer calves from their best cows. In most cases the bull calves are more a nuisance to merchandise than an asset. The effect of this use of embryo transfer is to increase the selection intensity of dams to produce female herd replacements.

In ET, an increase in reproductive rate of females offers the opportunity to reduce the number of dams that need to be selected for the next generation. At the same time, it leads to an increase in the amount of information available on sibs for estimating the breeding values (BV) of male as well as female selection candidates.

Embryo transfer also allows superior females to have an effect on the genetic change. However, this technology has been only beneficial to cattle where the low reproductive rates and the long generation intervals make it economically viable. So far, ET has had some experimental and limited practical applications in most developing countries. Limitations in utilization of AI and ET are attributable to the absence of organized breeding schemes, poor infrastructure, and a lack of human and institutional capacity.

The use of sexed semen alters the sex ratio in favor of either sex. It is a great advantage for the dairy industry for producing replacement heifers. The availability of sexed semen in dairy cattle has been eagerly anticipated for many years, and recent developments in fluorescence-activated cell sorting have brought this technology to commercial application. For a long time, the large-scale application has been hindered by slow process of semen sorting and the lower conception rates.

Semen sexing provides the potential to increase the numbers of offspring of one sex in a closed population, thereby increasing the intensity of selection for that sex. Semen sexing, however, enhances the farmers' ability to obtain a larger number of replacement heifers from their own herds. This enables farmers to expand their herd size without the need for buying replacement heifers from other farmers.

Other advancements in reproductive biotechnologies include biotechniques like cloning, gene transfer, cryo-preservation of embryos, in vitro maturation, fertilization and culture which may have very limited application in the developing countries due to the high cost and advanced infrastructural requirements for their implementation.

Breeding Schemes/strategies

Sustainable livestock genetic improvement strategies that meet the needs of farmers and take the prevailing production system into consideration can make a vital contribution to food security and rural development. This requires the implementation of efficient, sustainable breeding schemes. In most of the developing countries the lack of such schemes is one of the hindrances to the contribution of the livestock sector to food production and income generation.

Developing such a scheme for tropical environments is a challenging task constrained by small flock-size, communally shared grazing, uncontrolled mating, and the absence of pedigree and performance recording. To address these issues the advances in this area include nucleus/group breeding scheme and community-based breeding system.

Nucleus/group breeding scheme is based on the principle that in each herd there is a small number of genetically very superior animals which − if brought together − will form a nucleus whose average genetic merit is far greater than that in any of the contributing herds. The important element in this scheme is therefore for a group of farmers to agree to pool their high performing animals.

The main advantage of the nucleus scheme is that the genetic superiority of sire replacements coming into the base herds from the nucleus is far greater than what is achievable in each of the base herds. It is particularly attractive in situations where within-herd selection programs are ineffective due to small population size or inadequate technical skill.

The nucleus breeding scheme shifts the responsibility of operating the breeding program from the farmer to the nucleus herd. It is therefore an attractive method for the smaller communities because of the limitations discussed earlier. However, the organization of the scheme may have to be under government control because cooperative ventures among farmers may not always be practicable. As a result, implementation of nucleus breeding schemes in low-input environments has sometimes proven to be somewhat difficult. The alternatives to centrally organized nucleus schemes are community or village-based selection schemes, which are breeding activities carried out by the communities of smallholder farmers.

Community-based breeding system is a breeding program that involves local communities and institutions in the design implementation and ownership of breeding strategies. Its main objective is to improve the productivity of local breeds and thereby improve the income of rural farmers by ensuring access to improved animals that respond to improved feeding and management. Developing and implementing a community-based breeding program involves a series of interconnected activities and includes a description of the production system, definition of breeding goals, evaluating market access and policies,

development and implementation of a locally adapted breeding strategy.

Community or village-based breeding programs are intended to overcome the problems related to genotype–environment interaction, to avoid the genetic lag between the nucleus and the village populations, and are also appropriate for in situ conservation of indigenous animal genetic resources. Village-based breeding programs also help to bridge the gap between the skills of the breeders and the farmers. Currently village or community-based breeding programs have gotten wide popularity and they are being implemented in a number of developing countries in Asia and Africa mainly for the genetic improvement and conservation of small ruminants.

Conclusion

Millions of people in India suffer from food insecurity, drought, conflict, a weak infrastructure and a limited livelihood base. To achieve greater food security, in addition to boosting agricultural output, there is a need to create more diverse and stable means of livelihoods to insulate the rural poor and their households from external shocks.

Livestock kept under the prevailing small-scale conditions and traditional systems of production has a low level of productivity. Therefore, traditional systems of production alone can not be the best solution to feed the ever growing population and to address the pressing issues of food insecurity. One of the most important and reliable alternatives is the use of better technology. Therefore, science and biotechnology will have an important role to play in promoting the livestock-sector in India. A rational and informed use of some of the above mentioned advances in animal biotechnologies and breeding strategies is thus important.

Of the different biotechnologies, a well organized use of artificial insemination in animal breeding that is based on local models is highly recommended. Artificial insemination is widely used in most developing countries and the demand is growing. It has been instrumental in many countries for disseminating the genetic potential of elite sires to farmer's herds.

Embryo transfer could have a major impact on cattle breeding in the region, especially if it is taken as part of a nucleus breeding scheme. Embryo transfer is beneficial in increasing the utilization of superior dams.

An open nucleus breeding is a scheme where a nucleus herd/flock is established under controlled conditions to facilitate selection. The nucleus is established from the "best" animals obtained by screening the base (farmers') population for outstanding females. If well managed, open nucleus breeding schemes allows for greater selection intensity and could be one of the preferred methods of operation for quick genetic gain in indigenous, exotic or stabilized crossbred populations. However, in most low-input environments the implementation of nucleus breeding schemes has proven to be somewhat difficult due to the needed long-term commitment of sponsors and involvement of farmers.

Alternatively, there is now much interest towards community or village-based breeding programs. The system allows active involvement of the communities from the definition of breeding goals and selection criteria to the identification and implementation of the most appropriate and acceptable strategy.

In summary, proper adoption of some of the advances in animal breeding and biotechnology will have great potential to improve livestock productivity and food security. In view of the impressive results achieved in developed countries through the use of such advances in livestock production, there should also be good prospects for adoption of similar technologies to improve the productive potential and efficiency of livestock. The adoption of new technologies should be gradual and tailor-made as the adoption levels and their corresponding impacts are dependent on the level of infrastructure as well as human and institutional capacity developments in the target countries.

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FLORICULTURE AS AN UPCOMING INDUSTRY IN INDIA: PRESENT SCENARIO AND FUTURE PROSPECTS

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The production of horticultural produce has acquired much importance in recent times due to their increasing demand. Changing lifestyles of people across the globe and attempts to overcome the stressful lifestyle, and inclination towards healthy and luxurious life style has given boost to the overall growth of horticulture along with the flower industry in India as well. Thus, commercial Floriculture has, in recent times, emerged in the form of lucrative flora Industry as Government of India has identified it as a sunrise industry, and accorded it 100% export oriented status. Owing to steady increase in flower demand in the country, floriculture has become one of the important Commercial trades in Agriculture, an economical viable option in Agri-business. As per Agricultural and Processed Food Products Export Development Authority (APEDA), commercial floriculture has been viewed as high growth industry as hi-tech activity-taking place under controlled climatic conditions inside greenhouse and is gaining importance from the export angle. The demand for fresh flowers has steadily increased not only for decoration but also for many other purposes like essential oils, cosmetics, aroma therapy, dry flowers, pot-pourries, natural dyes, medicines, etc.

Global Scenerio

At global level, flora business is around US$ 176 billion, which is expanding day by day and with an annual average growth rate of 10.3 per cent, is expected to reach US$ 250 billion by 2025 (Global Horticulture Market Outlook 2015). Flowers and foliage accounted for around 52.45 per cent, and live plants, bulbs and cuttings accounted for 47.55 per cent of total floriculture products at global trade (APEDA 2014). International trade in floriculture, to a large extent is organized along regional lines. Developed countries in Europe, America and Asia account for more than 90 % of the total world trade in floriculture products. Germany is the leading country in floriculture trade with 17.04% share, followed by USA (10.57%) and Netherlands (10%) while India falls on fifty second rank (0.08%). Roses contribute around 16.43% of the total floriculture trade. In recent years, a paradigm change in the flora industry has been observed and has lead to the development of new productions centers in Asia and Africa which were earlier concentrated in USA and Europe. In Asia, India, China and Thailand are moving progressively in this direction and emerging leading countries. Asia-Pacific countries are the main suppliers to Japan and Hong Kong. African and other European countries are the principal suppliers to Europe's main markets, and the supplies to the United States are mainly catered by Colombia and Ecuador.

Indian Scenario

In our country, flowers are grown in around 233,000 ha land, with the production of loose flowers around 1729,000 MT and that of cut flowers 76732 lac numbers (2012-13), as per NHB 2013 database. However,

the contribution by numerous ornamental nurseries is excluded from these statistics due to unavailability of data although pot plant industry forms the major part of the world flower trade (>30%). The area under flower production has increased by 40%, loose flower production by 75% while cut flower production by 60% in last five years, as trend depicted from Table 1. Tradition of growing flowers is observed in the whole country. Loose flowers like marigold, china aster, jasmine, crossandra, barleria etc occupy major flower cultivated area of the country as the domestic consumption is very high. Tamil Nadu, Karnataka and Andhra Pradesh are the leading loose flower producing states. Cut flowers like rose, tuberose, gladiolus, chrysanthemum etc are highly popular and widely cultivated in the country. West Bengal, Karnataka, Maharashtra, Andhra Pradesh and Orissa are the leading cut flower producing states. Further, the trend of protected cultivation of cut flowers is also increasing in recent years in the country. Major flowers cultivated are rose, gerbera, carnation, etc. under polyhouse mainly in Maharashtra, Karnataka, Uttrakhand and Gujarat. Orchids like Dendrobiums, Vanda, Paphiopedilums, Oncidiums, Phalaenopsis and Cymbidiums and Anthuriums are grown under net house mainly at Sikkim, Arunachal Pradesh and Kerala. Liliums, Alstroemeria, tulips, etc are cultivated in Kashmir, HP and Uttarakhand.

Table1. Area and Production trend of flower cultivation in India

YEAR	AREA (IN '000 HA)	PRODUCTION	
		LOOSE (IN '000MT)	CUT (IN LAKH NOS.)
2006-07	144	880	37175
2007-08	166	868	43654
2008-09	167	987	47942
2009-10	183	1021	66671
2010-11	191	1031	69027
2011-12	254	1652	75066
2012-13	233	1729	76732

(Source: NHB Database 2013)

Exports from India

In view of floriculture exports, an exponential growth of floriculture products was being observed in 2006-07 when the exports reached to 649.6 crores. But since then, down fall to 340.14 crores (2007-8), 368.81 crore (2008-9), 294.46 crore (2009-10) and 296.04 (2010-11) has been witnessed owing to the downfall on the world economy. However, an overall rise with the establishment of a large number of export oriented cut flower units which has given a recognition to Indian flowers in the international market and the growing dry flower industry that contribute to 60-70% in the exports. With this, little rise in exports is witnessed, 365.32 (2011-12), 423.23 crore (2012-13) in the past two years (APEDA 2014), figure 1.

Rose cultivation in greenhouse

Important cut flowers exported from India include Roses, Lilies, Carnations, and Orchids. Major importers of flora products from our country are USA, Netherlands, Germany, United Kingdom, Japan, Canada and Japan. Thus, there exists the great potential and vast opportunities for export of cut flowers. Other associated activities of flower growing in India include the dry flower industry and the essential oil industry.

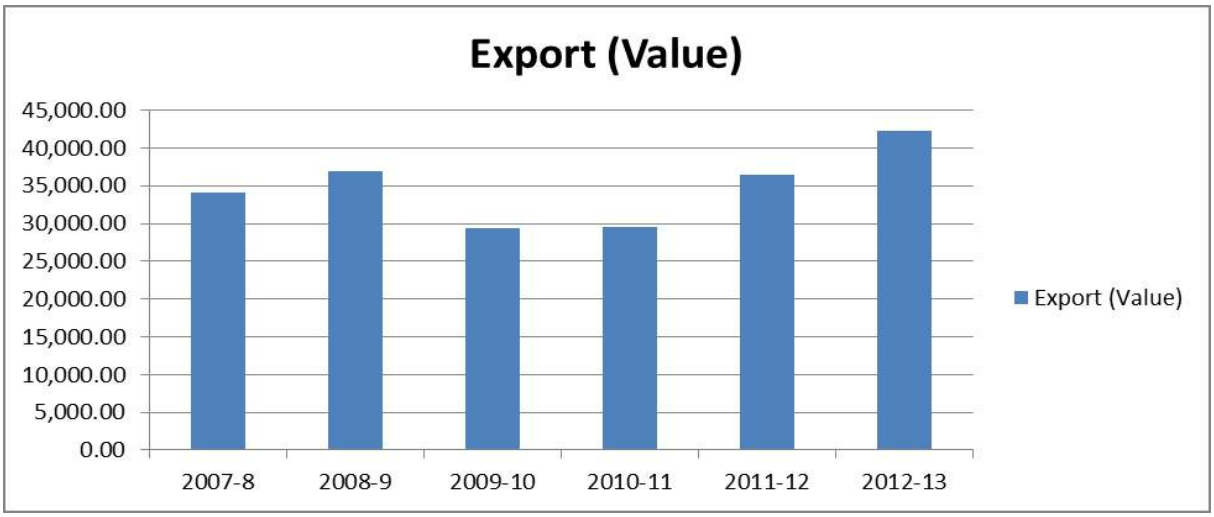

Fig 1. Export of Floricultural Products from India (Value, Unit: lac Rs)

India is the fifth largest exporter of dried flowers, and second largest exporter of dried foliage in the world accounting for around 7 per cent of world exports in dry flowers and foliage. The main export markets for India's dry flower industry are USA, Netherlands, UK and Germany.

Major flower producing sites

Loose flowers like marigold, china aster, jasmine, crossandra, barleria etc occupy major flower cultivated area of the country as the domestic consumption is very high. Tamil Nadu, Karnataka and Andhra Pradesh are the leading loose flower producing states. Cut flowers like rose, tuberose, gladiolus, chrysanthemum etc are highly popular and widely cultivated in the country. West Bengal, Maharashtra, Karnataka, Orissa and Gujarat are the leading cut flower producing states. Further, the trend of protected cultivation of cut flowers is also increasing in recent years in the country. Major flowers cultivated are rose, gerbera, carnation, etc under polyhouse mainly in Maharashtra, Karnataka, Uttrakhand and Gujarat. Orchids like are Dendrobiums, Vanda, Paphiopedilums, Oncidiums, Phalaenopsis and Cymbidiums and Anthuriums are grown under net house mainly at Sikkim, Arunachal Pradesh and Kerala. Liliums, Alstroemeria, tulips etc are cultivated in Kashmir, HP and

Uttarakhand. High value flowers like Asiatic ginger lily, protea, heliconia, bird of paradise, etc. are being cultivated in comparatively smaller area but these fetch higher returns per unit area owing to high flower value. Such high value flowers are being cultivated in southern states of our country. Flowers like rose, jasmine, tuberose, etc are generally known to rich in essential oils.Loose flowers like Aster, jasmine, croassaendra etc are cultivated in Maharashtra, Karnataka and Tamilnadu. *Rosa damscena* is exclusively cultivated for extraction of essential oils, rose water, attar, gulkand, etc in Haldighati (Rajasthan) and some parts of Kanauj (UP) and Himalchal Pradesh. Production of seasonal flower seeds for all three seasons is also a highly lucrative business which is well established in Punjab and Karnataka.

Orchids

Marigold

Trade and Marketing Sector

Marketing of cut flowers in India is much unorganised at present. In most metropolitan cities, that have large market potential, flowers are brought to wholesale markets, which mostly operate in open yards under open sky without any temperature regulation, cold storage facility and special potharvest care. Big flower merchants generally buy most of the produce and distribute them to local retail outlets after significant price mark up. Thus flower trade is based on grower- wholesaler agent-retail agent-consumer. The loose flowers (traditional crops like Marigold, and Jasmine) are usually traded by weight. The average price of different flowers in major markets varies considerably depending on the period of availability. The retail florist shops also usually operate in the open on-road sides, with different flowers arranged in large buckets. However, in recent years, some modern florist show rooms have come up in some metro cities, where flowers are kept in controlled temperature conditions, with considerable attention to value added service be it in terms of flower arrangements or bouquets, proper packaging and tinting and dry flower articles. Further, growth of flora-industry is reflected in the number of new florist outlets in cities, and increase in the public purchase of flowers as gifts. Further, with the development of some export oriented units and flower grower association with growing awareness for quality, the facilities of pre-cooling chambers, cold

stores and reefer vans have been set up but only limited to few projects. However, in the recent years, trade through wholesale or direct sale channel has been on the rise.

Future Prospects

Today, a significant growth in Indian floriculture is observed and a significant increase in acceptability of Indian flowers in the global market is perceived. Indian floriculture is slowly progressing towards becoming globally competitive with the new global trade rules under the WTO regime. The growing urbanization and changing lifestyles have given a boost to the per capita consumption of flowers and plants and as a result flower retail shops and boutiques have mushroomed all over the cities and towns. Thus, Flora Industry in India is shining and holding great promise with immense investments and employment opportunities along with several challenges. Here, pockets in Maharashtra, West Bengal, South Gujarat, are fast approaching towards becoming 'A hub of Floriculture' in near future and soon may become a candle of inspiration for the entire India. Also, a large number of export oriented units have created facilities of pre-cooling chambers, cold stores and reefer vans and their produce coming for domestic market sales are also, thus, of good quality and have longer vase life, and fetch higher price. Further, research based on postharvest and transportation problems observed in cut flower trade need to be focused and innovative approach and ideas among growers need to be encouraged. Efforts are needed to popularize cut flower use among the high income group in the country and indigenous flowers outside the country. Further, nursery industry need to be given boost and should be considered as a major component of floriculture as it is being excluded so far. In view of the unorganized set up, it is difficult to estimate the size of flower trade, both in terms of volume and value. Realizing the importance of floriculture's contribution to national agricultural economy, the Government of India has introduced many developmental programmes through the schemes of Ministry of Agriculture implemented under (National Horticulture Board), National Horticulture Mission, Ministry of Commerce and Industry, implemented by (APEDA) and Technology Mission for North Eastern States. All these have generated ample scope for the industry to expand in domestic and global sales. Today, flowers have become an integral part of ceremonies, they are yet to enter our homes and offices on regular basis and to explore at industrial level. There is a need to promote and explore the flower trade in addition with the other value addition techniques including pot plant trade along with infrastructural support and market intelligence study as major steps for strengthening the flower trade in India. Thus, potential for flower industry in India, including production for domestic and export sales of flowers and plants is unlimited, provided the challenges are converted into opportunities through strategic planning, creating awareness, infrastructural development and collaborative and cooperative approach.

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PROSPECTS OF TILAPIA FARMING IN GUJARAT REGION

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The state of Gujarat is blessed with large inland fisheries resources which include rivers, lakes, ponds, tanks and estuaries and brackish water areas. The total length of river and canals accounts for 3,865 km. while the area under major and medium reservoirs is about 2.55 lakh ha. In addition ponds and tanks (0.22 lakh ha), estuarine area (0.21 lakh ha) and water logged area (6,000 ha) is available in the state. The production from inland fisheries resources in year 2011-12 was 91,231 metric tonnes with major contribution from Catla, Rohu, Mrigal, Minor carp, Wallago- attu, Murrel, and catfishes.

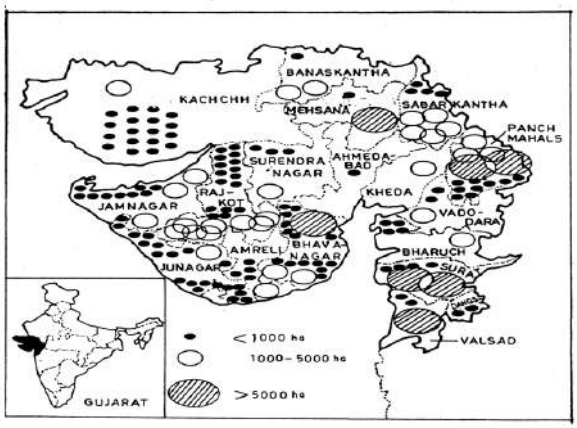
Table No 1: Inland Water Resources in Gujarat State

Sr. No.	Resources	Unit	Area
1	Village pond/ tank	Lakh Hact.	0.22
2	Small irrigation tank	Lakh Hact.	0.93
3	Medium & large reservoir	Lakh Hact.	2.55
4	Rivers and canals	KMS.	3865.00
5	Estuarine area	Lakh Hact.	0.21
6	Brackish water area	Lakh Hact.	3.76
Sardar Sarovar Narmada Project Expected Area To Be Developed			
1	Reserviour area	Hact.	34867
2	Command area pond/ tank	Hact.	10500
3	Water-logged area	Hact.	6000
4	Esturine area	Hact.	500

(Source- Gujarat Fisheries Statistics 2011-12)

FISH SEED PRODUCTION

Availability of fish seed is very important for aquaculture development. Since the establishment of the first Chinese circular hatchery in the state in 1976 Lingda farm. There are total eight hatcheries in the state of Gujarat. Fish spawn and fingerling production in Gujarat in 2007-2008 was 1327.32 lakh.



Reservoirs in Gujarat

Sr. No.	Name of Farm	Village	Year of construction
1	Palan	Palan	1989-90
2	Thala	Thala	1986-87
3	Bhadrania	Bhadrania	1984-89
4	Lingda	Lingda	1975-76
5	Kosmada	Kosmada	1988-89
6	Pipodara	Pipodara	1981-82
7	Ukai	Ukai	1982-83
8	Umarvada	Umarvada	1988-89

Looking at present scenario, the majority of freshwater aquaculture activity is confined to Indian major carps. To further increase the scope of fish production, introduction of newer varieties can be helpful. One of such fish species having good aquaculture good aquaculture prospects may be Tilapia. Tilapia is a generic term which is used to designate a group of commercially important food fish belonging to the family Cichlidae. Tilapia species are used in commercial farming systems in almost 100 countries and are developed to be one of the most important fish for aquaculture in this century (Fitzsimmons, 2000). Tilapia are known as ‘‘aquatic chicken’’ because of their fast growth, good quality flesh, disease resistance, adaptability to a wide range of environmental conditions, ability to grow and reproduce in captivity, and feed on low trophic levels. Therefore, they have become an excellent choice for aquaculture, especially in tropical and subtropical environments (El-Sayed 2006).They are able to produce high quality protein from less refined protein sources thus making them ecologically attractive as sources of animal protein for humans (Jauncey, 1998). Tilapia fingerlings can be grown to an acceptable size for local markets (~150g live weight) in six months (Green *et al.*, 2000). There are roughly 70 species of tilapia found in nature (ISSG, 2006), out of which *Oreochromi niloticus* is cultured worldwide.

World production of tilapia

World tilapia production has been booming during the last decade, with output doubling from 8,30,000 tonnes in 1990 to 1.6 million tonnes in 1999 and to 3.5 million tonnes in 2008 (FAO 2012). China is by far the main tilapia producing country, with 1.1 million tonnes production in 2008. Egypt reported an impressive increase between 2007 and 2008. Production in Indonesia and the Philippines, too, increased significantly during the past decade to over 3,00,000 tonnes each. Major tilapia production is mainly due to Nile tilapia (*Oreochromis niloticus*). All new countries entering tilapia production concentrate on this species, which is easy to grow. In 2008, about three quarters of world tilapia production were Nile tilapia.

Export potential

China is the main supplier of tilapia to the international market with 2,60,000 tonnes in 2009. Out of this amount, some 1,34,000 tonnes went to the USA and about 19,000 tonnes to the EU market. In addition, China exported 36,000 tonnes to Mexico and 22,000 tonnes to Russia. Africa, mainly Egypt and Côte d’Ivoire, followed by Israel are important importers of tilapia from China.

Farming system

Tilapia are cultured in different farming systems i.e. Mixed-sex culture, male monosex culture, polyculture, integrated culture.

Mixed culture

Mixed-sex populations of fry are cultured together and harvested before or soon after they reach sexual maturity, thereby eliminating or minimizing recruitment and

over crowding. A restricted culture period limits the size of fish that can be harvested. Species such as *Tilapia zilli, T. hornorum,* or *Oreochromis mossambica* are not suitable for mixed-sex culture because they reproduce at an age of 2 to 3 months and at an unmarketable size of 30 grams or less. Tilapia suitable for mixed-sex culture are *T. aurea, Oreochromis nilotica* and their hybrids, all of which reproduce at an age of 5 to 6 months.

Male monosexculture

Males are used for monosex culture because male tilapia grows faster than females. Females use considerable energy in egg production and do not eat when they are incubating eggs. Male monosex culture permits the use of longer culture periods, higher stocking rates and fingerlings of any age. High stocking densities reduce individual growth rates, but yields per unit area are greater. If the growing season can be extended, it should be possible to produce fish weighing one pound (454 grams) or more. Expected survival for all-male culture is 90 percent or greater. A disadvantage of male monosex culture is that female fingerlings are discarded**.**

Polyculture

Tilapia is frequently cultured with other species to take advantage of many natural foods available in ponds and to produce a secondary crop, or to control tilapia recruitment. Polyculture uses a combination of species that have different feeding niches to increase overall production without a corresponding increase in the quantity of supplemental feed. Polyculture can improve water quality by creating a better balance among the microbial communities of the pond, resulting in enhanced production**.**

Resent studies proves that Tilapia can be cultured with channel catfish (*Ictalurus punctatus*) with only a minor reduction in catfish yields. Male tilapia stocked at a rate of 800/acre yield nearly 770 pounds/acre when channel catfish are stocked at 3,000/acre. Other polyculture system consists of tilapia and prawns (*Macrobrachium rosenbergii*). In polyculture, survival and growth of tilapia and prawns are independent. Feed is given to meet the requirements of the fish. Prawns, which are unable to compete for the feed, utilize wasted feed and natural foods that result from the breakdown of fish waste. Stocking rates for 1 to 2 gram prawns vary from 4,000 to 36,000/acre, but a rate of 8,000/ acre is often used to obtain a high percentage of market-size prawns (<25 grams) and a yield of about 445 pounds/acre.

Polyculture of shrimp with tilapias may provide an opportunity to develop a sustainable aquaculture system (Fitzsimmons, 2001). Tilapia-shrimp polyculture is practiced in a wide range of salinity levels from 0 to 30 %. Tilapias used in the polyculture include red tilapia (*Oreochromis spp*.), Nile tilapia (*O. niloticus*), and Mossambique tilapia (*O. mossambicus*).

INTEGRATED CULTURE

Chicken/fish farming

Maximum tilapia yields are obtained from the manure output of 2,000 to 2,200 chickens/acre, which deliver 90 to 100 pounds (dry weight) of manure/ acre/day. Broiler flocks should be composed of three size groups to stabilize manure output. Several crops of chickens can be produced during a fish production cycle**.**

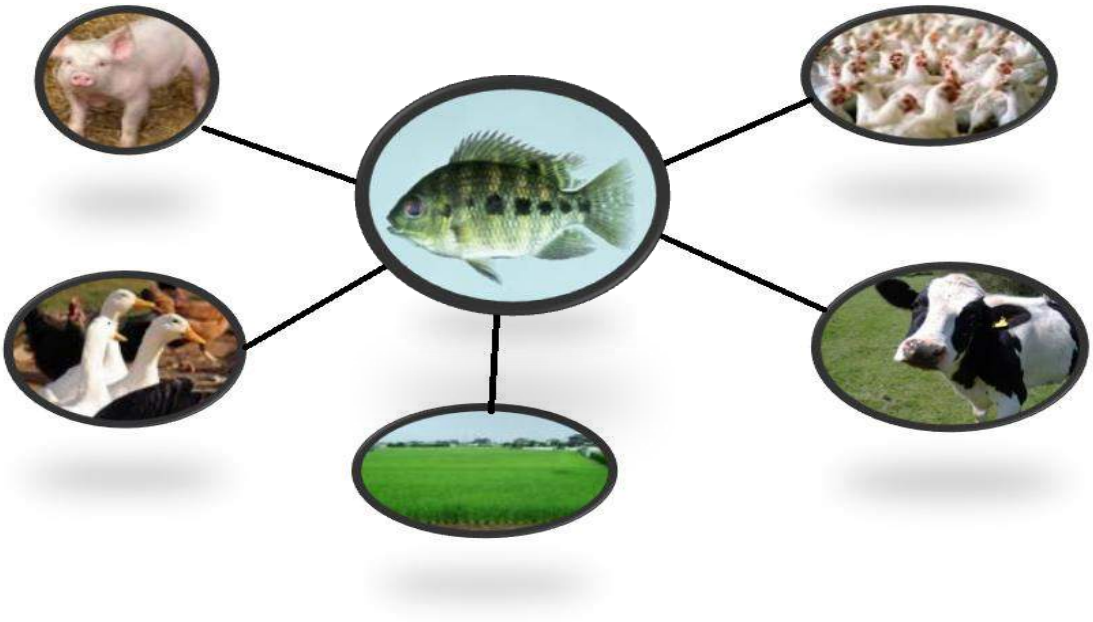
Pig/fish farming

Approximately 24 to 28 pigs/acre are required to produce a suitable quantity of manure (90 to 100 pounds of dry

matter/acre/day) for tilapia production. The pigs are usually grown from 44 to 220 pounds over a 6-month period.

Duck/fish farming

Ducks are grown on ponds at a density of 300 to 600/acre. The ducks are generally raised in confinement, fed intensively, and allowed access to only a portion of the pond where they forage for natural foods and deposit their manure. Ducks that arc raised on ponds remain healthier than land-raised ducks. Also by raising ducks on ponds, feed wasted by the ducks is consumed directly by the fish. Since ducks reach marketable size in 10 to 11 weeks, staggered production cycles are needed to stabilize manure output.



Integrated farming of tilapia

Indian scenario

In India, tilapia (*Oreochromis mossambicus*) was introduced in 1952, with a view to filling up unoccupied niches, such as ponds and reservoirs. The species spread all across the country within a few years due to its prolific breeding and adaptability to wide range of environmental condition. Overpopulation of the species affected the fisheries of several reservoirs and lakes as in Vaigai, Krishnagiri, Amaravati, Bhavanisagar, Tirumoorthy, Uppar and Pambar reservoirs in Tamil Nadu, Walayar, Malampuzha, Pothundy, Meenkara, Chulliar and Peechi reservoirs of Kerala, Kabini reservoir of Karnataka and Jaisamand Lake of Rajasthan. Introduction of *O. mossambicus* in Jaisamand lake not only resulted in reduction of average weight of major carps, but also posed threat to species like mahseers (*Tor tor* and *T. putitora*), which are on the verge of extinction. The Fisheries Research Committee of India had imposed ban on tilapia propagation in 1959. The Nile tilapia was introduced to India during late 1970s. In 2005, River Yamuna harboured only negligible quantity of Nile tilapia, but in two years' time, its proportion has increased to about 3.5% of total fish species in the river. Presently in the Ganges River system, proportion of tilapia is about 7% of the total fish species. However, tilapia holds vast promise to become an important species for aquaculture in India, considering the demand for more fish. M/s Vorion Chemicals,

Chennai had successfully cultured and marketed some varieties of tilapia, and reported neither escapes to natural water bodies nor any ecological threats.

There are many unpublished data about the availability of tilapia in reservoirs of Tamil Nadu and some other states of India. In the Kolkata Wetlands, some farmers are producing mono sex tilapia on commercial scale in waste water. Studies carried out at CIFA for a period of three years during 1998 to 2000 with GIFT tilapia had demonstrated production levels of 5-6 mt per crop of 4-6 months duration. Further, the study also showed the possibility of tilapia farming under polyculture with the three Indian major carps and showed higher growth over rohu and mrigal at similar stocking levels. Monosex population (all male) also could be produced with provision of 17á Methyl testosterone treated feed for four weeks. Only four fish farmer groups, M/s Aresen Bio Tech, A.P, Vijaywada, M/s Ananda Aqua Exports (P) Ltd., Bhimavaram, A.P, M/s Indepesca Pvt. Ltd., Mumbai M/s CP Aqua (India) Pvt. Ltd., Chennai, and M/s Rajiv Gandhi Centre for Aquaculture (RGCA), the R & D arm of the Marine Products Export Development Authority (MPEDA) are already permitted by Government of India for the seed production and farming of tilapia (Mono sex and mono culture of Nile/GIFT/golden tilapia) in accordance with the guidelines for the hatchery operation and farming of tilapia, developed by the Sub-Committee under the National Committee on Introduction of Exotic Aquatic Species into Indian Waters.

Potential for tilapia culture in Gujarat

As the demand for fish is increasing, diversification of species in aquaculture by including more species for increasing production levels has become necessary. Introduction of tilapia in Gujarat is advantageous because it represents lower level in food chain, and thus its culture will be economical and eco-friendly. Mono sex culture of tilapia is advantageous because of faster growth and larger and more uniform size of males. Also the cage culture of tilapia in inland water bodies may be beneficial for getting more production. There is high potential of export of tilapia to US, Europe and Japan.

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BAMBOO TEXTILES: SUSTAINABLE AND ECO -FRIENDLY TEXTILES

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Bamboo textiles are cloth, yarn, and clothing made out of bamboo fibres. While historically used only for structural elements, such as bustles and the ribs of corsets, in recent years a range of technologies have been developed allowing bamboo fibre to be used in a wide range of textile and fashion applications. Bamboo is abundantly available in many rural areas where economic development is limited, so it can offer a social benefit as well. Through research and development of more ways to utilize bamboo, rural areas are afforded an opportunity to maintain their culture and lifestyle while improving their economic situation. Bamboo's versatility is evidenced by its use for income, food and housing. Different species are used for different purposes, including food for Pandas, humans and livestock, woven handcraft products such as baskets and mats, textile products, ingredients for Chinese medicines and construction of flooring, fences and roofing.

Bamboo for Clothes and its Properties

Bamboo makes a wonderful clothing material. Due to its hollow fiber, it has unusual breathing capabilities. The fiber is filled with micro gaps and micro holes, which allow for better moisture absorption and ventilation than other fibers.

1. **Comfort**: Bamboo apparel is comfortable, very breathable, moisture-wicking, fast drying and thermal regulating.
2. **Antibacterial**: Bamboo is naturally antibacterial due to a bio-agent that the Japanese have called "kun," which resists the growth of bacteria on the fiber.
3. **Thermal Regulating**: Wouldn't it be nice to have a fabric that makes you feel cooler in hot weather and warmer in cool weather.
4. **Superior Wicking Capability**: Bamboo fiber is highly absorbent, much more so and faster drying than cotton.

5. **Hypoallergenic**: Bamboo is naturally hypoallergenic, which means it's less likely to cause an allergic reaction in sensitive individuals.
6. **Wrinkle Resistant**: Bamboo clothing is naturally more wrinkle-resistant than cotton.
7. **Colorfast**: Bamboo accepts organic and natural dyes more rapidly and thoroughly, with less dye use, than cotton, modal or viscose (Rayon).
8. **Easy Care and Energy Efficient**: Bamboo is machine washable in cool water. Environmentally unfriendly and unhealthy fabric softeners are not needed or recommended.

Bamboo Farming

Bamboo is fastest growing woody plant on this planet. It grows one third faster than the fastest growing tree. Some species can grow up to 1 metre per day. Bamboo is just grass, but it varies in height from dwarf, one foot (30 cm) plants to giant timber bamboos that can grow to over 100 feet (30 m). It grows in many different climates, from jungles to high on mountainsides. Bamboo farming is typically a very environmentally responsible, renewable and sustainable practice. Practically all bamboo comes from China. China has often had a "bad rap" for unfair labor and environmentally destructive practices. However, like anywhere else, it depends on the individual circumstances, people and factories that are producing the goods.

Advantages of Bamboo Farming

- ***Environmentally Responsible****:* Chemical pesticides and synthetic fertilizers are not needed in the growing of bamboo, as it is seldom eaten by insects or infected by pathogens. In addition to this reduced consumption and impact of petroleum-based chemicals, there is the secondary effect that petroleum consuming and polluting tractors are not used nearly as much as with other crops.
- ***Water Conserving:*** Bamboo also has relatively low water needs, especially compared to cotton and most other crops. Bamboo does extremely well in impoverished soils. Bamboo roots help retain water in a watershed area due to their tight hold on the soil. It's been reported that compared to an equivalent stand of trees, bamboo takes in more carbon dioxide, removing this green house gas from the atmosphere, and produces 35 percent more oxygen than trees.

- ***Renewable and Sustainable Resource:*** The entire plant is never harvested and re-growth occurs naturally and rapidly. Bamboo is one of the fastest growing plants in the world. It can grow to its full height in three months and then be ready to harvest in three to four years as its thickness fills out. In fact, it's hard to stop it from spreading, as anyone knows who's planted it in their back yard. Bamboo is

increasingly plantation- raised to fulfill the growing demand for it. Plantation grown may be beneficial or detrimental, depending on how it's done and the wages paid to workers.

- ***Biodegradable:*** Bamboo, as a natural cellulose fiber, is biodegradable in soil by microorganisms and sunshine. The decomposition process doesn't cause any pollution to the environment. However, a biodegradability problem may arise if bamboo is blended with synthetic elastic such as Lycra®.

Bamboo Processing

There are two basic means of processing bamboo to make the plant into a fabric: mechanically and chemically. One mechanical method crushes the woody parts and uses natural enzymes to break the bamboo stalks into a pulp so the natural fibers can be mechanically combed out and spun into yarn. Another mechanical method crushes the woody parts of the bamboo plant into a powder, which is mixed with water.

Either mechanical process is more labor intensive and costly than the chemical process, so they aren't used very often. In the chemical process, a harsh chemical is often used to break the bamboo stalks into a pulp. This can be more or less environmentally friendly, depending on whether or not the chemical is captured and re-used. Non-toxic chemicals may be used and also may or may not be recovered and re-used.

End-use of bamboo fibre: Bamboo fabrics are made by pure bamboo fibre yarns, which have excellent wet permeability, moisture vapour transmission property, soft hand, better drapery, easy dyeing, and splendid colours. It is a newly founded, great prospective green fabric.

The following are some of the end-use of bamboo fibre:

- Bathrobes and towels
- Mats
- Bed clothes
- Underwear
- Bamboo T-shirts
- Foot mats
- Bamboo sock

Bamboo intimate apparels include sweaters, bath-suits, mats, blankets, towels have comfortable hand, special lustre and bright colours, and good water absorbance. Bamboo fibre has such a sole function as anti bacteria, which is suitable to make underwear, tight T-shirt and socks. Its anti-ultraviolet nature is suitable to make summer clothing, especially for the protection of pregnant ladies and children from ultraviolet radiation.

Bamboo nonwoven fabric is made by pure bamboo pulp, which has same property as viscose fibres. However, bamboo has wide prospects in the field of hygiene materials such as sanitary napkin, masks, mattress, and food-packing bags due to its anti-bacteria nature.

Bamboo sanitary materials include bandage, mask, surgical clothes, nurses wears and so on. The bamboo fibre has natural effects of sterilization and bacteriostasis, therefore it has incomparably wide foreground on application in sanitary materials such as sanitary tower, gauze mask, absorbent pads, food packing and so on. In the medical scope, it can be

processed into the products of bamboo fibre gauze, operation coat, and nurse dress, etc. Because of the natural antibiosis function of the bamboo fibre, the finished products need not have additions of any artificial, synthesized, anti-microbial agent, so it will not cause skin allergy, and at the same time, it also has competitive prices in the market.

Bamboo decorating series has the functions of antibiosis, bacteriostasis and ultraviolet-proof. It is very advantageous for utilization in the decorating industry. Along with the badly deterioration of atmosphere pollution and the destruction to the ozonosphere, the ultraviolet radiation arrives the ground more and more. Long time exposure to ultraviolet irradiation will cause skin cancer. But the wallpaper and curtains made from bamboo fibre can absorb ultraviolet radiation in various wavelength, thus lessen the harm to human body. What is more, bamboo decorating product will not go mouldy due to the damp. Curtain, television cover, wallpaper and sofa slipcover can all be made by bamboo fibre.

Bamboo bathroom series enjoy good moisture, soft feel and splendid colours as well as anti-bacteria property, which are well popular in home textiles. Bamboo towel and bathrobe have soft and comfortable hand feeling and excellent moisture absorption function. Its natural antibiosis function keeps bacterium away so that it won't produce bad odour.

Conclusion

The merits of bamboo for use in textile fibres are their breatheability, ease of processing them into fabric, their high functionality and beauty. The fashion world's fascination with novel things like bamboo is attracting the interest of a number of designers. More and more of this materials end-products are expected to find their way into store shelves in the years to come. The bamboo plant allows textile manufacturers to produce items that have all of these qualities. In our continuing search for ways to reduce our impact on the environment while still being able to enjoy the luxuries of our modern age, bamboo offers a smart solution to at least one environmental issue: how to take an abundant resource and use it to the advantage of both people and the planet. By growing and harvesting the plant sustainably, using responsible manufacturing processes, and producing items that are useful, beautiful, and environmentally sound, viscose from bamboo could be the fabric of the future.

ERGONOMIC INTERVENTIONS IN DESIGNING HOME: A WAY OUT OF SAFE LIVING

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Abstract

Ergonomics is used to describe the science of "designing the job to fit the worker, not forcing the worker to fit the job." Ergonomics covers all aspects of a job, from the physical stresses it places on joints, muscles, nerves, tendons, bones and the like, to environmental factors which can affect hearing, vision, and general comfort and health. Ergonomics is traditionally used as a perspective for analyzing work-situations but has also been used when analyzing the home environment. Ergonomics application is equally important for designing housing space, interiors, household equipments and so on. The basic principle of ergonomics can be successfully employed for designing different units of a home. An ergonomic home is that person's basic needs are fulfilled and met without many problems in the Environment. Proper ergonomic design is necessary to prevent repetitive strain injuries, which can develop over time and can lead to long-term disability. Ergonomics can be successfully applied to design a home for safe and comfortable living. The present article throws light on the ergonomics interventions while designing a home.

Ergonomics (or human factors) is the scientific discipline concerned with the understanding of the interactions among humans and other elements of a system, and the profession that applies theoretical principles, data and methods to design in order to optimize human well-being and overall system performance.

Three main domains of expertise for investigating interaction between humans and socio-technical systems were identified - physical, cognitive and organizational ergonomics.

Physical Ergonomics deals with the anatomical, anthropometric, physiological and biomechanical parameters in static and dynamic physical work. Among the main topics are the physical postures that people adopt when they are working, fatigue and other problems associated with handling physical and musculo-skeletal tasks associated with physical efforts.

Cognitive Ergonomics is a subdiscipline of ergonomics that studies the cognitive processes at work with an emphasis on an understanding of the situation and on supporting reliable, effective and satisfactory performance. This approach addresses problems such as attention distribution, decision making, formation of learning skills, usability of human-computer systems, cognitive aspects of mental load, stress and human errors at work.

Social or Organizational Ergonomics deals with the optimization of sociotechnical work systems, including their structures, policies and organizational processes. Thus, ergonomists are often involved into the social

design of communication systems, interaction routines within the working groups, times and shifts schedules in a company, and other related issues.

Principles of Ergonomics

In their 1998 paper "The Universal Design File: Designing for People of All Ages and Abilities," Story, Mueller, and Mace outlined seven principles of what has come to be known as "Universal Design" in North America, and "Inclusive Design" or "Design for All" in other parts of the world. These are -

1. **Equitable use:** The design is useful and marketable to people with diverse abilities.
2. **Flexibility in use:** The design accommodates a wide range of individual preferences and abilities.
3. **Simple and intuitive use:** Use of the design is easy to understand, regardless of the user's experience, knowledge, language skills, or current concentration level.
4. **Perceptible information:** The design communicates necessary information effectively to the user, regardless of ambient conditions or the user's sensory abilities.
5. **Tolerance for error:** The design minimizes hazards and the adverse consequences of accidental or unintended actions.
6. **Low physical effort:** The design can be used efficiently and comfortably, and with a minimum of fatigue.
7. **Size and space for approach and use:** Appropriate size and space is provided for approach, reach, manipulation, and use, regardless of the user's body size, posture, or mobility.

It is certain that when ergonomic principles are ignored in the workplace, health hazards are potential outcome. However, the reduction of health hazards, specially MSD-risk is only one of the many goals of physical ergonomics. Many risk factors are identified, that may cause health hazards at work, such as

Awkward postures: People working in awkward and uncomfortable postures are more vulnerable to have MSDs, for example reaching behind the body, twisting, working overhead, kneeling, forward or backward bending, and squatting. The more the joint departs from the neutral position, the greater the likelihood of injury.

Excessive force: When a task requires more exertion like lifting, lowering, pushing, pulling, pinching and so on, causes MSD's.

Repetition: Repetition is a measure of the number of times the same motion is completed in a given amount of time. The risk of an MSD increases when repetition is combined with other risk factors, such as force, duration, and posture.

Static muscle loading: Standing, sitting, or otherwise remaining in one posture for a long duration while performing a task can increase the likelihood of injury. The combination of force, posture, and duration creates a condition that quickly leads to muscle fatigue. There is a direct link between fatigue and lost productivity.

Vibration (hand/arm)*:* Vibration transmitted through the hands through direct contact with a vibrating source can lead to vascular, muscular, or neurological disorders.

Lighting: Proper lighting is an important consideration for enhancing productivity, safety and reducing heath hazards at work place. .

Ergonomic interventions can reduce these health hazards to some extent. Ergonomics is

traditionally used as a perspective for analyzing work- situations but has also been used when analyzing the home environment. The basic principle of an ergonomic home is that person´s basic needs are fulfilled and met without many problems in the Environment. Hence, the present article throws light on the ergonomics interventions while designing a home.

Ergonomics interventions in the Home

Housing may affect family life either favorably or adversely, depending on the provisions it makes for routine activities of the household. There is a need of ergonomic application for designing a safe and comfortable home. While designing different units of a home, the capabilities and limitations of users should be taken into account. Following considerations are fundamental for designing an Ergonomic home-

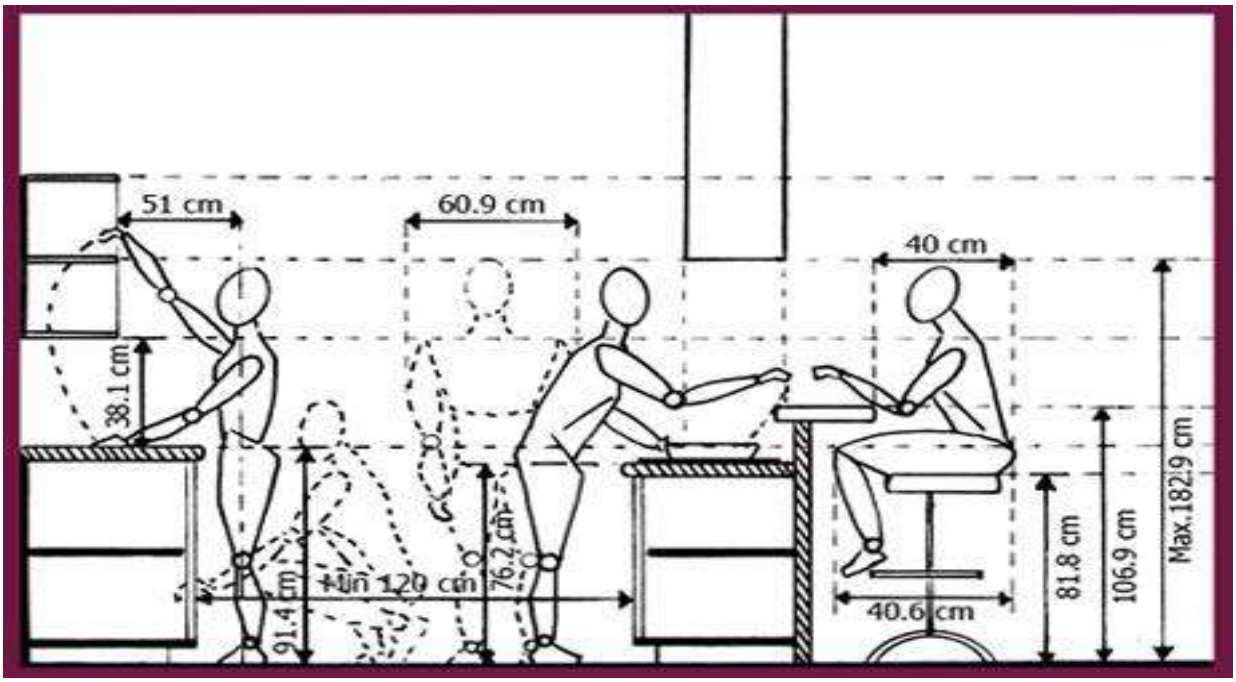
- Designing household equipment and systems so that they are as easy to use as possible and less likely to cause damage to the user when used.
- Designing household equipment and that reduces awkward postures for the application.
- Organizing the layout of the home, so that it reduces unnecessary tasks and movements to increase efficiency and productivity
- Tilting and lifting containers to bring work to a proper height and increase efficiency
- Designing the environment so that lighting and temperature are at optimal levels. Every work surface should be well lighted, ventilated without any glare and shadow.
- Designing of a workstation to allow the proper height and reach to perform the task so that the body's posture is improved and the loads on the body are reduced. It should be at or below elbow height for most job tasks.
- Designing furniture in the home which are fit for users and reduce discomfort.
- Adjusting chair or work stool height according to leg length and the height of the work surface. An adjustable chair should be with a stable base, adequate padding, good low-back support, proper back and hip support, and the seat doesn't hit the back of the knees.
- Proper space should be allowed so that legs can be outstretched.
- Handgrips and tools used in work should fit into hand size.
- Workstation should be arranged to avoid over-stretching and unnecessary twisting.

1. Ergonomics in kitchen

In kitchen layout, the basic concept is to minimize walking back and forth a lot, with clear pathways between work centers. The current kitchen can have four or more centers. The distance between work centers should be more than 4 ft. but less than 9 ft. and an island or other obstacle should not intersect the path by more than 12 inches. No major traffic pattern through the kitchen should intersect the paths between work centers.

Work surface height and design- Working height is an important element to consider when designing a comfortable workspace. It is a major determinant of a person's posture when standing. If the working level is too high, shoulders and upper limbs will be raised – fatigue and strain of shoulder muscles can result, making it difficult to exert downward force if a task requires it.

To accommodate the different tasks to be done in the kitchen and the people of different heights doing them, counter surfaces should either be adjustable or set at various heights. Proper work surface height minimizes excessive forward bending and shoulder elevation. For tasks requiring close visual inspection, position the surface height so that hands are slightly higher than elbow height and below shoulder level. For most tasks, the work surface should be slightly below elbow height.



Adjustable height cooktops, sinks, and cupboards are needed to accommodate wheelchairs or an extremely wide range of user heights. The minimum area recommended by the architects for the kitchen is 120 sq. feet.

Reach and access dimensions in cooking area

Floors- Prolonged standing on hard work surfaces can create contact trauma and pain in the feet. A cushioned floor surface such as cork or linoleum is best, and it minimizes breakage when things are dropped. If the floor is hard, such as tile, anti-fatigue mats or cushioned rugs should be used to increase blood flow to the feet and to reduce fatigue.

Lighting- In addition to general lighting, every work surface should be well illuminated by task lighting.

Standing- Static postures cause blood to pool in the lower extremities, resulting in muscle fatigue and pain. The worker often stands in one position while cooking or preparing food. Static postures should be avoided by continually changing position.

Reaching- Reaching should be minimized by organizing work station so that most cooking processes can be completed within easy reach while keeping elbows close to the worker body. Most commonly used tools should be placed within easy reach. All ingredients and utensils needed before cooking should be assembled near the work center. A stepstool

should be used to avoid reaching above shoulder height.

2. Ergonomics in bathroom

Ergonomic design focuses on maximizing comfort for the maximum number of people. The two basic spatial requirements are "clearance" and "reach". Clearance involves the consideration of minimum spatial tolerances required to give a person access in constrained circumstances e.g. when bending down to open a cupboard door in passageway.
Reach is concerned with the workspace envelope which a body can comfortably occupy in a given position and situation (e.g. the distance at which a standing person can reach overhead).
In a bathroom, a working height 50-100 mm below the fixed elbow is generally recommended. When designing a bathroom, following points should be kept in mind:

- Sliding doors, support bars on the sides and front should be provided. Height of the shower must be reachable for the smallest adult and to be high enough for taller ones thus, head knocking is to be prevented.
- Taps, shampoos and toilet soap must be reached by someone sitting inside the bathtub. A minimum width for the shower box should be 90 cm.
- Resistant material for the shelf insides should be used.
- Frontal mirror with lights and amplifying mirror and brush storage should be fixed. A light above the mirror or recessed lighting in the ceiling should be avoided, that throws strong light directly on the forehead.
- Cabinets with doors and space to move the legs (or wheel chair, when necessary) should be provided.
- Easy to use tap and stop knobs should be placed in an easy access area.
- Taps with half circle, lever and/or unique command or cells sensitive to light may be used.
- Indian bath requires some part of the floor **3'x3'** in the comer to be in the lower level by about 3 inches than the remaining and a smoothly dressed stone **15"x15".**
- Entire floor of the bathroom should have a flooring of polished flag stones slab or unglazed tiles, walls around should be lined with glazed tiles to a height of at least 3' .
- Items concerned with similar functions should be grouped together.

3. Ergonomics in the bedroom

The most important furniture in a bedroom is a comfortable and ergonomically designed bed. The main function of a bed is to provide body support during sleep in a way that allows the musculoskeletal system to recover from daily activities.
Hence, the following point should be kept in mind while designing an ergonomically safe and comfortable bedroom-

- The bed should be at a comfortable height to enable person to get on and off easily without straining the back.
- The mattress should be firm without being hard.
- As a general rule lighter people need softer mattresses while heavier people need firmer ones.
- Importantly, the mattress should be even i.e. it shouldn't have any lumps; and should be replaced when worn out.
- It's important for pillows should be of the right height – not too high and not too thin.

- While sleeping on the back or side, the pillow should adequately support the neck to avoid straining it and follow the natural curve of the spine.
- A small cushion placed below the knees can reduce strain when sleeping on the back.
- The bedside table should be close to the bed. This allows a person to easily reach for a book or a glass of water without stretching too much.
- Lighting fixtures should be thoughtfully designed so that they illuminate different areas of interest. Placing of lighting fixtures in a bedroom should be such that it provides flexibility for performing various activities such as reading, talking, sleeping and so on.
- Combination of general lighting and task lighting is required in a bedroom.
- Chairs, tables, and footstools should be easy to relocate, thereby making the space amenable to a wider range of uses, while each furniture piece would be able to accommodate persons of every size and ability.

4. Ergonomics in a living room

- Floor area and size of the living room should be considered for setting up the furniture in a living room.
- Sofa should be comfortable and the feet of users should touch the floor comfortably.
- There should be a flexible cushion at the lower portion of seat back to support lumbar of the user.
- When positioning TV/PC screens ensure that they are at the right height for eye focus so there is no strain. TV's should be wall mounted or standing in a position that is comfortable for all people to watch so their head and neck do not feel strain.
- A combination of general lighting, accent lighting and task lighting should be used for flexibility in a living room. General lighting that brightens objects and surfaces in the lower part of the room creates a feeling of warmth and intimacy.
- Accent lighting directs extra light and thus extra attention to selected objects and surfaces.
- Whereas, task lighting enables the person to perform work like reading, games and other hobbies.

Conclusion

Ergonomics is concerned with the design of space in which people carry out work. Ergonomics is the science of designing the job, equipment and workplace to fit the worker. Proper ergonomic design is necessary to prevent repetitive strain injuries, which can develop over time and can lead to long-term disability. Ergonomics can be successfully applied to design a home for safe and comfortable living. Ergonomically designed interiors create living spaces that are not only "easier" to live in, but by virtue of this ease, facilitate "happier" living.

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