Chapter 3

KNOWLEDGE, SCIENCE, TECHNOLOGY AND ENVIRONMENT

3.1 Growth of Knowledge and Human Colonisation of New Environments

Students of human evolution trace human dominance of the earth to their invasion of the cognitive niche, to their ability to elaborate knowledge. This permitted people to tap an enormous range of food resources from roots and tubers, fruits and berries, to fish, fowl and large mammals. They also elaborated ways of shielding themselves against extremes of weather by construction of shelters and clothing. All of this knowledge was deployed to permit them to move beyond their ancestral home of tropical savannahs and colonise much of land barring extreme deserts, highest of mountains like Himalayas and polar regions.

Progress over land by foot required no advances in knowledge. Crossing short stretches of seas, probably on logs also did not need any special knowledge. So people seemed to have reached Australia as early as 40 thousand years ago; they colonised the America using a land bridge in Bering straits during the last ice age.

But colonisation of more remote oceanic islands like Hawaii, New Zealand and Madagascar required development of greater navigation skills and more seaworthy crafts. This was accomplished slowly between 2000 to 500 years ago.

The latest major episode of colonisation of new environments is that of outer space, beginning with the launch of Sputnik over 50 years ago and with landing of man on moon and establishment of space stations.

3.2 Growth of Knowledge and use of Newer Resources

A number of examples of more and more intensive use of energy resources, moving from use of human muscle power to animal muscle power, from wood to coal to petroleum, from shallower to deeper and deeper deposits to less dense energy sources such as shale are provided in the write up "Changing global patterns of energy and water consumption — from ancient to modern times" in section 7.1. Similarly, the same theme talks of more and more intensive use of water resources, moving from use of surface to ground water to desalinated sea water. All of this is related to growth of science and technology.

Similar examples are seen in the use of a variety of materials. Initially people primarily depended on natural materials such as stone, wood and bone. The first major departure was use of metals. Most metals naturally occur in oxidised forms and development of techniques of obtaining these in reduced form by use of substances like wood charcoal permitted a whole range of new uses. Over time, metals requiring higher and higher energy inputs such as aluminium have been brought into use. The next major innovation has come with growth of modern chemistry and development of a whole range of synthetic materials like plastics, polyfibres, pesticides, detergents and so on.

3.3 Growth of Knowledge, Control of Diseases and Population Growth

The developments and sophistication in food production, health care, etc., that we see today in the world we live in, has resulted from the steady advancement of knowledge since the dawn of human civilisation. It has taken thousands of years to reach this far and there is no sign of knowledge making an end.

The history of medical knowledge has also gradually improved from ancient to modern times beginning with intuitive and observational propositions to using sophisticated machines and instruments to diagnose health problems. During the second half of the 20th century there evolved a common international goal towards health resulting in the setting of international objective of "Health for all" by 2000 AD under the initiative of World Health Organisation. Different countries contributed towards achieving this target.

As mentioned earlier, the evolution of medicine is as old as human civilisation. It is thus considered as one aspect of the history of culture. The Indian medical system is considered to be one of the oldest systematically practiced medical systems. It included the Ayurveda and the *Siddha* System whose origin is traced back to about 5000 BC. Chinese, Egyptian, Mesopotamian, Greek, Roman medicine, were followed by preventive and the modern scientific medicine at the close of the 19th century.

With the advent of the modern medicine, over the years, the tools of diagnosis have become refined, sophisticated, specific and potent. Since then there has been a tremendous growth of specialisation in response to advances in medical technology due to changes in the nature and distribution of health and disease pattern. Many specialities and super specialities emerged such as surgery, radiology, anaesthesia – some based on parts of the body. At the same time, chances of getting cured became more tough and at a high cost. But with the introduction of preventive and social medicine, there has been a concerted effort by different groups such as Government, NGOs, Trusts, etc., towards eradication of diseases from the society as a whole through free immunisation programmes, disinfection of public places, free medical treatment, environmental management, etc. As a result of this, many diseases have been eliminated completely or almost completely or prevented from resulting into an epidemic, some of which are discussed here.

1. Smallpox: Till 1970, smallpox was a major killer throughout the world. The smallpox causing virus was eradicated from human population through vaccine. The WHO declared on 8 May 1980 that smallpox has been eradicated from human population.

2. Influenza: Influenza virus was also a major killer throughout the world. Influenza pandemic occurred

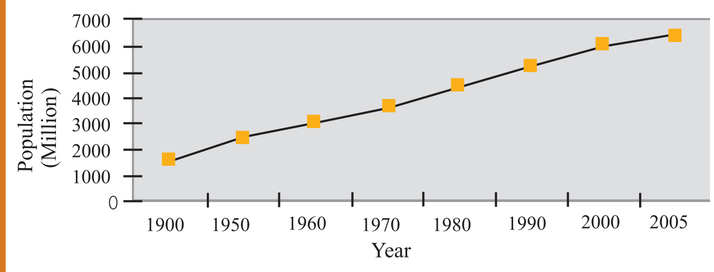
occasionally such as in 1918-19. It affected more than 50 million people and killed as many as 20 million. In India alone, over 6 million people died. Another pandemic occurred in 1957, which affected over 1000 million people worldwide. In India, over 2.5 million were officially reported to have fallen sick with 765 deaths. The next pandemic occurred in 1968. But with the availability of various types of vaccines, prophylactic and curative drugs, the number of lives lost have reduced to very small numbers during epidemics and pandemics that followed thereafter.

3. Tuberculosis (TB): Tuberculosis was also once considered a deadly disease but today the number of deaths has decreased drastically over decades. This has been possible due to BCG vaccination since 1950s and other chemoprophylactic treatments available now. The rough estimate of mortality from tuberculosis per 100000 population was 400 in 1920-21; 200 in 1950-51; 100 in 1964; 60-80 in 1980 and even lower now. The life span of TB patients has also increased tremendously.

Not only diagnostic tools, prophylactic and curative measures have improved tremendously, so also were inventions towards birth control measures and manufacture of various contraceptives throughout the world, especially in the developed countries since 1970s.

Advancements in prevention and eradication of diseases along with birth control measures showed their impacts on the population trends. Given below is the human world population beginning with the introduction of modern medicine (Fig. 3.1a)

A closer look at the trend in population growth indicates that there has been more or less a gradual increase in population till 1950. But thereafter a sharp increase has been observed till 1980. This could be attributed to the advancements taking place in medicine since 1950s. The world human population interestingly did not show the expected increase since 1980s. It can be noted here that, since the late '70s, population control measures came to be introduced in most parts of the world. This means that though death rates showed sharp decline due to advancement in health care, food security, etc., correspondingly, birth rate also showed a decline resulting in controlling the population growth rate. For example, China introduced birth control measures in



Note: Year not to scale

Fig. 3.1a: World population growth

1971 persuading its citizens not to have more than 2 children. In 1979 it introduced a more aggressive plan of offering incentives for late marriages and having just one child who would get provision of free medical care, schooling, employment, cash bonus, housing, etc. Along with this package was introduced an equally strong and harsh penalty for giving birth to a second child. As a result of this, between 1972 and 2000, the crude birth rate fell by 50 per cent.

However, in India, the population growth did not show a trend similar to the world population. A steep and steady increase has been observed since '50s (Fig. 3.1b). The Government of India's initiative for Family Welfare Programme towards maintaining small family with slogans such as "Hum do hamare do" took much longer time to be accepted and become effective. Nevertheless, various birth control measures started picking up pace thereafter. The decline in birth rate since the early '90s

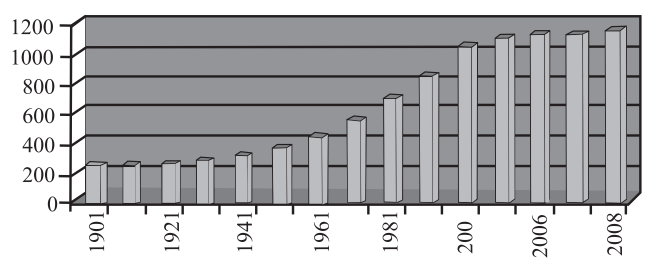


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Fig. 3.1b: Population growth in India

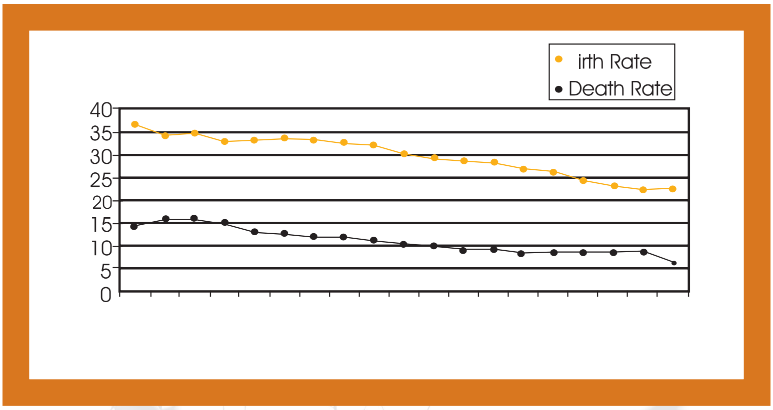


Fig. 3.1c: Crude birth and death rate in India

can be attributed to this. However, the corresponding decline in India's crude death rate exceeds the crude birth rate (Fig. 3.1c) contributing to increase in population.

With this trend in population growth continuing, India is expected to be the most populous country by 2050 with an estimated population of 1928 million.

3.4 Implications of Intellectual Property Rights for Environment

Intellectual property rights are the rights given by law to those who have produced something of value by using the creativity of the mind. Paintings, music, inventions, brand names, trade marks, designs, books are all the result of creativity and can all be protected by using intellectual property rights.

There are eight main forms of intellectual property rights. These are copyright, trademark, geographical indication, design, patent, plant variety protection, layout-design of integrated circuits, and confidential information. Each of these covers a different kind of subject matter and is governed by its own law. The table below shows the different forms of intellectual property rights.

The main intellectual property rights relating to the environment are geographical indication, plant variety protection and patent rights.

A geographical indication is granted when a product possesses a special characteristic because it comes from or is associated with a particular geographical location. It may have developed a special quality because of the unique features of the area from which it is derived,

	Intellectual Property	Right Law	Subject Matter
1.	Copyright	Copyright Act, 1957	Literary, dramatic, musical and artistic works, movies, sound recordings, performances, broadcasts.
2.	Trade Mark	Trademarks Act, 1999	Trade marks and trade names of goods and services.
3.	Geographical Indication	The Geographical Indications of Goods (Registration and Protection) Act, 1999	Goods that possess a characteristic or quality because of the geographic location from where they originate.
4.	Design	The Designs Act, 2000	Features of shape, ornament, pattern etc., of a product that appeal to the eye.
5.	Patent	Patents Act, 1970	Inventions
6.	Plant Variety Protection	The Protection of Plant Varieties and Farmers' Rights	Plant varieties that is uniform, stable Act, 2001 and distinct.
7.	Layout-Design of Integrated Circuits	The Semiconductor Integrated Circuits Layout-Design Act, 2000	Layout of transistors and other circuitry elements.
8.	Confidential Information	No special law	Valuable information that is kept as a secret.

or it may have a special reputation connected with the geographical location. Darjeeling Tea, Kancheepuram Silk, Mysore Sandalwood Oil and Orissa Ikat are all geographical indications that have been granted in India. This intellectual property right enables the genuine manufacturer to prevent any unauthorised person from using the geographic indication to describe his or her goods.

Under the plant variety protection law, a plant breeder's right is granted to a person who has bred a new plant variety. A farmer's variety can also be granted protection, even if it is not novel. However, this intellectual property right can be refused if granting it would be contrary to public order or morality, or not in the interests of human, animal or plant life and health. It can also be refused if it could cause serious prejudice to the environment. Plant varieties involving genetic use restriction technology and terminator technology cannot be protected as these technologies are considered to be harmful. New plant varieties are often developed from germplasm that has been used, developed or conserved over generations by local communities. In such a case, the local community concerned can apply for and be granted compensation for its contribution to the evolution of the protected variety.

A patent is granted for an invention. If the invention involves the use of biological material, the source and geographical origin of the material used must be stated. This makes it possible to monitor the use of biological diversity in the manufacture of patented products. Just as in the case of plant varieties, a patent can be refused if the intended use of the invention is contrary to public order or morality, or can cause serious prejudice to human, animal or plant life or health or to the environment.

These intellectual property rights demonstrate a concern for the environment. No protection is given to any intellectual property that might cause serious environmental harm. In addition, before applying for any intellectual property right based on an Indian biological resource, the approval of the National Biodiversity Authority is necessary. While granting its approval, the National Biodiversity Authority may impose conditions to ensure the equitable sharing of benefits with local bodies and benefit claimers. If any intellectual property is applied for abroad, and it is based on India's biodiversity or traditional knowledge, the National Biodiversity Authority can oppose such an application. Thus environmental concerns have been reflected in the intellectual property rights system.

3.5 Biotechnology, Agriculture, Health and Environment

Biotechnology, which involves controlled usage of biological processes, finds wide application in many aspects of our everyday life. In simple terms, biotechnology employs micro-organisms to convert simple organic molecule e.g., sugars etc., into more useful products e.g., alcohol, butanol etc. Though the term biotechnology has originated recently, it is an age-old discipline, which has been observed in making of wine, vinegar, and curd etc., activities that are dated back to 5000 BC. The quest in the field continued and showed an upward trend from penicillin production to Recombinant DNA technology and enzyme engineering. Today we see a marked role of biotechnology in improvement of agriculture, health care and environmental protection besides many others.

Biotechnology and Agriculture

The field of plant biotechnology by use of plant parts (cells, tissues and organs) generates useful products and services which help in improvement of agriculture. It has led to improvement in both quantity and quality of crops. With the help of plant tissue culture rapid clonal multiplication of plants through vegetative parts like adventitious shoot, bulb, protocorm etc., have been made possible. This process called micro-propagation is being utilised in India for commercial production of mainly ornamental plants and fruit trees, e.g., banana.

The most notable and widespread application of biotechnology though in agriculture by far is in engineered crops. Thousands of such products have been field tested and over a dozen have been approved for commercial use. The traits most introduced into crops are tolerance to herbicides, insects, virus and stress. Introduction of these traits not only increase the yield but also reduces the load of hazardous chemical used in agriculture on the environment. Currently available commercial herbicide tolerant crops are tolerant to three herbicides based on three active ingredients i.e., bromoxynil, glyphosate and glufosinate. As of insect tolerant plants all commercially available ones contain a version of the toxin *Bacillus thuringiensis* (Bt) which is found in nature in soil bacteria e.g., Bt cotton. A major apprehension among farmers and environmentalists is that the wide use of Bt crops will lead to the development of resistance to the toxin which will render Bt toxin useless as a pesticide. Papaya and squash are the two virus tolerant plants currently approved for commercial use. Nitrogen fixing plants have since long been used by farmers to replenish the nitrogen in the soil. High on researchers' list is to introduce the feature of nitrogen fixation in non-leguminous plants which would allow farmers to decrease their use of synthetic fertilisers while maintaining high yields; result in nitrogen from fertilisers retaining in the soil; and enhance productivity in many regions of the developing world whose farmers cannot afford nitrogen fertilisers. Crop breeders through genetic modification can also use biotechnology to discover genes of value in wild species and transfer them into crops. This will expand the genetic variation in stable crops as desirable traits are bred into them. This will significantly expand the gene pool used in modern agriculture reducing risk of crop failures and also expand wild relatives of modern crop plants that might be threatened to extinction.

Thus using biotechnology in agriculture will ensure fewer agricultural inputs such as fuel, labour, water and fertiliser; reduce overall chemical stress on the environment while increasing yield and food quality.

Biotechnology and Health

Contribution of biotechnology in health care is more prominent, frequent and more rewarding both financially and psychologically. The major contribution of the field in this sector can be grouped under the following broad categories such as: (i) disease prevention, (ii) disease detection, (iii) therapeutic agents, (iv) correction of genetic diseases, and (v) fertility control and forensic medicines.

Vaccination/immunisation is the most desirable and convenient method of disease prevention, a field that shows the contribution of biotechnology. Vaccines help in effective prevention of the disease even for those diseases without cure. Eradication of small pox is an example of efficiency of vaccination. The Government of India is also undertaking a strong drive through vaccination for eradication of Polio. Vaccines can be conventional vaccines consisting of whole pathogenic organism, which can be killed or live (e.g., bacterial and viral vaccines). It can also be purified antigen vaccines based on isolated vaccines (e.g., polysaccharide vaccines for meningitis, pneumonia etc.) or recombinant vaccine produced by recombinant DNA technology. Efforts are already underway for production of edible vaccines, which are genetically modified plants or transgenic plants containing vaccines for a particular disease in their edible parts. Disease diagnosis is another area where biotechnology has helped replace the tedious and time-consuming conventional method with more precise and rapid methods through the use of (i) DNA/RNA probes, and (ii) monoclonal antibodies (Mab). Probes or small nucleotide (DNA/RNA) sequences are available for *Plasmodium* (malaria), *Wuchereria* (filaria), *Mycoplasma Tuberculosis* complex etc., Monoclonal antibodies are employed in classification of blood groups and in early and accurate detection of cancers. Identification of genes responsible for many ailments caused due to genetic disorders is very essential. Biotechnology can help in development of gene therapy. It can also aid in advising people who are carriers of such diseases on the chances of their children inheriting the disease. In addition, cases of such diseases can be reduced by early detection of the afflicted foetuses and thereby terminating such pregnancies. Therapeutic agents can be derived from micro-organism, plant and animal cultures using biotechnology.

Rapid increase of human population is also a concern and efforts are in the pipeline to produce fertility control vaccines, which are safe, effective and accessible. DNA finger printing, a part of biotechnology, is being widely used for solving cases related to crimes, establishing identity of victims of murder and accidents and also in paternal disputes.

Environment and Biotechnology

Technological development coupled with changing lifestyles of people has increased the load on environment. All the production systems adopted today mostly generate wastes, which are not biodegradable and cause harmful consequences on the environment. Various anthropogenic activities—domestic, agricultural, industrial, transport etc., contaminate air, water and soil. Consciousness towards the destruction of environment also has increased along with efforts being undertaken from every quarter to minimise degradation. With the use of biotechnology measures have been undertaken (i) to clean up the pollution generated by other technologies, and (ii) to produce technologies, which are comparatively cleaner. The various approaches to waste treatments may be grouped into the following five categories:

1. Biofilters (gases)
2. Landfill (solids)

3. Burning or incineration (solids)
4. Aerobic digestion (liquid)
5. Anaerobic digestion (liquid).

Biofilters are devices which consists of either a solid support or two-phased (gas/liquid) system and appropriate micro-organisms to convert gaseous wastes into non-hazardous compound. Solid wastes can be sorted out into biodegradable and non-biodegradable components. The latter may be recycled and the former may be incinerated or used for anaerobic digestion. But the cost of sorting the wastes being uneconomical, the entire solid waste is generally dumped into pits, the process is called landfill. Landfill is an approach used to treat solid wastes, like garbage and the solid remaining after liquid waste treatment. The wastes are used for landfill in which a natural or man-made pit is filled with the wastes. Landfill sites can be used as a source of biogas or may be a landscape, planted with vegetation. Liquid wastes are treated by either aerobic digestion in large centralised water reclamation or sewage treatment units. The solids or sludge recovered from liquid wastes may be disposed off as fertilizers in agricultural fields, disposed off into the sea, used in landfills with other wastes or incinerated.

Bioremediation is one approach in which biological organisms such as bacteria, fungi, plants and their enzymes are employed to eliminate toxic pollutants from contaminated sites. Bioremediation can be done *in situ*, i.e., on-site treatment of wastes or *ex situ*, i.e., treatment of contaminated water elsewhere. Bioremediation with the use of micro-organisms is either done with naturally occurring microbes or microbial inoculants developed in the laboratory and introduced at the site. In India, a bacterial inoculant, 'Oilzapper' has been developed from a consortium of bacterial species to clear oil spills and oil sludge. Not all contaminants can however be treated with microbes. Heavy metals like cadmium and lead are not readily absorbed by microbes. These may persist in the environment and build up their concentration with time and lead to bio-accumulation in the food chain. Many plants are hyper accumulators and can take up heavy metals and accumulate them upto considerable quantities. Such plants are used to clean up contaminated sites and this approach of using plants for reclaiming degraded sites is known as phytoremediation. This approach is significant due to environmental pollution with metals and xenobiotics (man-made chemicals present in the environment at high concentrations) and also due to prospect of future engineering of plants for clean up of environment. Some examples of phytoremediation are use of *Thlaspi caerulescens* for cadmium and zinc accumulation, *Brassica juncea* (Indian mustard) and poplar trees for lead and sunflower for arsenic.

3.6 Intellectual Property Rights over Living Organisms

Intellectual property rights can be granted over living organisms by means of plant variety protection and patent rights. Plant variety protection was available only after India enacted a law providing for such protection in 2001. A patent was available, but originally no patent was permitted in India over living organisms.

A patent is granted for an invention that is new, involves an inventive step, and is useful. The patent law was enacted with the industrial revolution in mind, when new and better manufacturing equipment and processes were being devised. The patent gave the patent-holder the exclusive right to the invention for a limited number of years. During that time, no one could make the invention without the patent-holder's consent. In return, the patent-holder had to disclose the complete details of the invention, setting out exactly how the invention was made. This information was available to the public, enabling others to learn from it. The patent system thus tried to balance the public good in rapid progress with the individual interest in making a profit from the invention.

Developments in biotechnology led to the ability to modify genes in living organisms. Such modified living organisms were originally not considered "inventions" and no patent was granted on them. The view taken was that all living organisms are the products of nature and belong to all mankind. No person could be granted an exclusive right over them. Some persons took the view that life is given by God; it is not made by man. So no living organism can be the invention of a human being, and no patent can be granted.

In the United States of America, a scientist of Indian origin named Ananda Chakrabarty developed a genetically modified bacterium that could degrade oil and was useful for clearing up oil spills. He applied for a patent in the

United States on this "oil-eating" bacterium. In 1980, the United States Supreme Court heard the matter and granted the patent. It said that "anything under the sun made by man" could be patented, including a living organism. Many countries disagreed with this view, including India, and continued to refuse patents on living organisms.

In 1995, an international agreement called the Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS Agreement) came into force. Under this Agreement, India agreed to allow patents on micro-organisms. Following this Agreement, the Patent Act was amended in 2002, permitting patents on micro-organisms. This was the first time that a patent on a living organism was permitted in India. While a patent on a micro-organism can now be granted in India, no patent is permitted on any other form of living organism, such as plants or animals.

Intellectual property rights over plants are generally granted through breeder's rights under the plant variety protection law. If a plant variety is new, uniform, stable and distinct, the breeder can get exclusive rights over it for a limited period of time. This would mean that a farmer who is not a breeder and who grows the protected plant variety is not allowed to save the seed for resowing the next year, which is a traditional practice amongst farmers. Other practices such as exchanging the seed grown on the farm with another farmer would also become illegal. To prevent this, a new form of protection called "farmers' rights" was also provided in India's plant variety protection law. India was the first country to provide such rights to its farmers. Because of the farmers' rights, the farmers' age-old practices of saving, sowing, using and exchanging seeds remain legal even when the breeder has been granted exclusive rights in the plant variety. The traditional farming practices of Indian farmers are, therefore, protected and can continue unchanged. A farmer can also be a breeder, and can get breeders' rights in new seed varieties that he or she may have developed.

Intellectual property rights over animals are not granted in India. Some countries do permit patents on genetically modified animals. Some limit is often placed on the grant of such patents. For example, in the European Union, the patent office is required to weigh any suffering likely to be caused to the animal against the possibility of substantial medical benefit to man before granting a patent. In Canada, “lower animals” are patentable while “higher animals” (including human beings) are not. However, no clear-cut line has been drawn between higher and lower animals.

No patent has as yet been granted on a human being. A large number of human genes, however, have been patented. Human embryonic stem cells have also been granted patents abroad.

The grant of patents on living organisms has been extremely controversial. Patents on seeds have been viewed as a threat to food security, since the supply of seeds is controlled by the patent-holder, who may refuse to supply seeds, or may only supply them at a very high price to those who need them. The patenting of plants and animals has been considered to be a privatisation of nature and biodiversity by the grant of exclusive rights to individuals and companies. The patenting of human cells and genes has raised questions of individual liberty and rights. It has been argued that the ownership of any part of the human body is akin to slavery. Another argument raised is that the grant of a patent on a human disease-related gene (such as a gene that causes cancer) to one person prevents all others from using that gene to develop a cure for the disease, thereby causing harm to humanity. Those who support such patents argue that modern biological research is very expensive, and that those who invest such large amounts need to be able to recover their investment through the grant of patents.

Different countries have taken different views on the patenting of living organisms. India has permitted the patenting of micro-organisms, but does not permit the grant of patents on plants, animals or human beings.

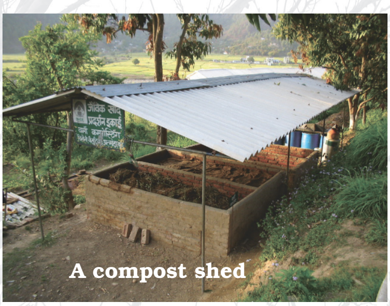
3.7 Traditional Indigenous Knowledge and its Implication for Environment

Traditional knowledge is held by communities and cultures over generations, and has deep cultural, economic and environmental significance. It includes a diversity of knowledge such as literary and scientific works, medical practices and agricultural techniques. Traditional knowledge about biodiversity can include the healing, agricultural and sacred properties of plants and animals, as well as conditions of cultivation and processing methods. Traditional knowledge is found in ancient texts, folklores and in the continuing practices and beliefs of communities. It is usually transmitted from generation to generation as oral knowledge. It is important to note that traditional knowledge is not static, but dynamic, constantly being shaped and changed by the innovations and practices of each generation.

Traditional communities depend on a high diversity of biological resources for their food, cultural, medical and housing needs. Their traditional knowledge about the use and value of biodiversity is a vital element in fulfilling their needs. This use of biodiversity-related traditional knowledge thus encourages the conservation of the biodiversity in their environment. Traditional knowledge is used in a variety of areas such as:

Healthcare: The Indian Systems of Medicine (Ayurveda, Siddha, Unani) encompass traditional knowledge and are part of the official healthcare system in India. In addition, traditional medical systems also include 'non-classical' traditional knowledge, such as tribal medicinal practices. Almost every tribe or forest community possesses knowledge about medicinal plants. For example, the Madav Koli tribals of the Western Ghats use 202 plant species for medical use and 109 plant species for veterinary use. All these systems of medicine depend on a wide diversity of biological resources. Thus, the needs of medical traditional knowledge have encouraged the conservation of the necessary species in the environment.

Agriculture: Farmers and livestock keepers have used, and innovated on their traditional knowledge to improve and nurture diverse varieties of crops and domesticated animals over generations. This has been invaluable in providing food security, healthcare and shelter. Traditional knowledge has therefore moulded and conserved agricultural biodiversity over generations to provide for human needs. For example, the state of Jharkhand is a drought-prone state, so farmers have developed local crop varieties with drought-tolerant features.


A compost shed

Till recently, at least 50,000 rice varieties were grown in India, developed by generations of farmers. The *Rebaris*, traditional pastoralists in Rajasthan, have developed the

Nari cattle breed, which is highly disease and drought resistant, with good draught survival qualities and milk with high fat content.

Biodiversity: All over India local communities have independently conserved wild ecosystems. They have done this for a variety of practical, social and religious reasons. Such conservation has to a large extent been based on traditional knowledge about the use, value, sustainability and carrying capacity of an ecosystem. For example, there may be community-imposed restrictions on the amount of a resource that can be harvested from a forest or marine fishing area, or prohibition of hunting methods that exhaust the number of a given species, or the creation of landscapes deemed as sacred and inviolate, such as sacred groves or sacred ponds. Some sacred areas are thousands of years old and dedicated to a local deity. For example, the sacred groves in Maharashtra are known as *Deorais*, which have conserved many of the best elements of forests in the region, and are also a valuable source of medicinal plants for local communities. In Uttara Kannada, a sacred grove dedicated to the goddess Karikannama contains the only remaining natural stands of *Dipterocarpus* and a large patch of *Myristica indica*.

It is also important to keep in mind that firstly, all traditional knowledge-based practices do not have a positive effect on the environment. For example, there may be a tendency to overuse some resources, such as in North-East India where several hornbill species are excessively hunted by tribal communities who use the beaks for medicine or for traditional headgear. Practicing of animal sacrifices for general welfare or as a treatment for some diseases or ailments are other examples. There are also many unfounded beliefs, which encourage the use of certain exotic varieties of lizards, or plant products for aphrodisiac purposes. Secondly, traditional knowledge is not all-encompassing – there can be gaps in knowledge about biodiversity, especially about elements that do not directly impinge on a community's life, such as micro-organisms, or insects that are neither directly useful (e.g., honey bees) nor agricultural pests. Owls and bats are considered inauspicious species in some communities.

The erosion of useful traditional knowledge may often lead to negative effects on the diversity of the environment, as tried and tested system of use and conservation practices breakdown.