

Traditional Knowledge in Different Sectors

1. Traditional Knowledge and Engineering
2. Traditional Medicine System
3. TK and Biotechnology
4. TK in Agriculture
5. Traditional Societies Depend on it for their Food and Healthcare Needs,
6. Importance of Conservation and Sustainable Development of Environment,
7. Management of Biodiversity
8. Food Security of the Country and Protection of TK

Traditional Knowledge and Engineering

Iron technology in India has a glorious tradition going back to the second millennium B.C. One can trace almost an uninterrupted history of metallurgical excellence, especially in ironworking right up to the British times. India produced the best iron and steel in the ancient world some of the examples that may be mentioned are the Delhi iron pillar, the Konark and the Dhar beams of extraordinary weight and length and the Wootz steel that was marketed in the ancient world as Damascus steel.

As a striking example, knowledge of navigation was a key input to British colonization and domination, and the "algorismus" and calculus imported from India, were key inputs to the development of navigation from 16th to 18th c. CE: specifically, to the calendar reform, and methods of calculating latitude and longitude.

In the history of modern hydrology, Marcus Vitruvius, who lived about the time of Christ, is considered the forerunner of the modern concept of hydrologic cycle. The modern science of hydrology may be considered to have begun in the 17th Century with observation and measurements. In the history of the Indian hydrology, the concept of hydrologic cycle and geohydrology and the techniques of water exploration and determination of water quality dates back to the Vedic Period. There are abundant examples of verses in Vedas, Puranas, Vrhata Sanhita and in other ancient Sanskrit works, which explain very clearly the concepts and techniques of hydrologic science. The fundamental objective of the present paper is to provide some of the important illustrations from the Vedic Science, which explain various concepts and techniques of modern hydrology.

Hydrologic Cycle is a fundamental and important concept in hydro-science. The cycle involves the total earth system comprising the atmosphere (the gaseous envelop), the hydrosphere (surface and subsurface water), lithosphere (soils and rocks), the biosphere (plants and animals), and the Oceans. Water passes through these five spheres of the earth system, in one or more of the three phases: solid (ice), liquid and vapour.

The Vedic texts which are more than 3000 years old contain valuable references to water and the 'hydrologic cycle'. As mentioned earlier, the most important concepts, on which the modern science of Hydrology is founded, are mentioned in Rig Veda in various verses in the form of hymns and prayers addressed to various deities and divinities such as Indra (firmament), Agni (fire), Maruts (wind) and so on. It means that the water which gets divided in minute particles due to the heat of sun is carried by wind and after the conversion into cloud it rains again and again.

Another verse of the Rig Veda states that the God has created sun and placed it so, that the whole universe gets illuminated, likewise this is the rule of universe to extract up water continuously and then convert it to cloud and ultimately discharge as rain.

In the Rig Veda, Sam Veda and Yajur Veda the concept of infiltration, water movement, storage and evaporation as the part of hydrologic cycle are revealed clearly. During the time of Atharva Veda the concept of water evaporation, condensation, rainfall, river flow and storage and again repetition of cycle was explained as in the earlier Vedas. According to the Atharva Veda, the sun rays are the main cause of rain and evaporation, has been deliberately mentioned in the vedas.

Like the knowledge of water science during the Vedic age and afterwards in the age of Epics and Puranas was highly advanced, although the people of those times were solely dependent upon their experience of nature, without sophisticated instruments of modern times. In the Vedic age, Indians had developed the concept that water gets divided into minute particles due to the effect of sun rays and wind, which ascends to the atmosphere by the capillary of air. It gets condensed there and subsequently falls as rainfall. Month-wise change in the facets of the hydrological cycle was also known. Water uptake by plants which gets facilitated by the conjunction of air along with the knowledge of infiltration is revealed in the ancient literature.

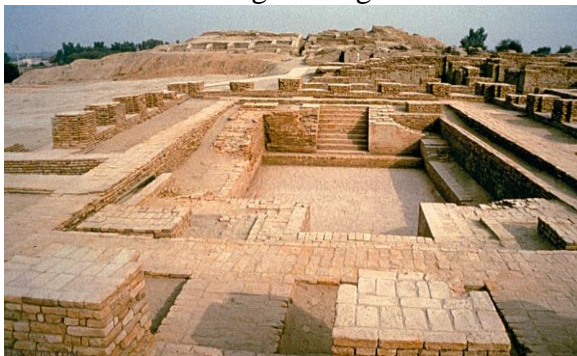
From all above discourses, we can conclude that well developed concepts of the hydrological cycle were known to the ancient Indians in those ancient times while the contemporary world was relying on the wild theories of origin and distribution of water. Thus, the ancient Indian knowledge of water science can be regarded as the great achievement of that time. Some pictorial illustrations of traditional knowledge in the field of engineering and architecture are provided below:



Traditional tools used in agriculture and farming



Traditional engineering hand tools



The Great Bath of Mohenjo-Daro



Ancient India's contribution to science and technology



Ancient eco-friendly house



Terracotta technology: a traditional and eco-friendly technology which has wide range of use.

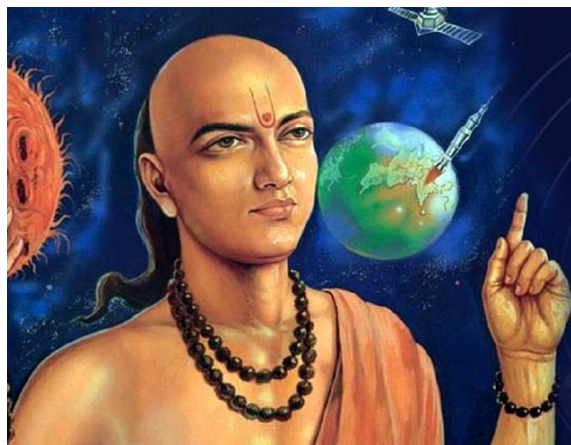


Sophisticated Water Reservoir at Dholavira, evidence for hydraulic sewage systems in the ancient Indus Valley Civilization

Contribution of ancient Indian scientists

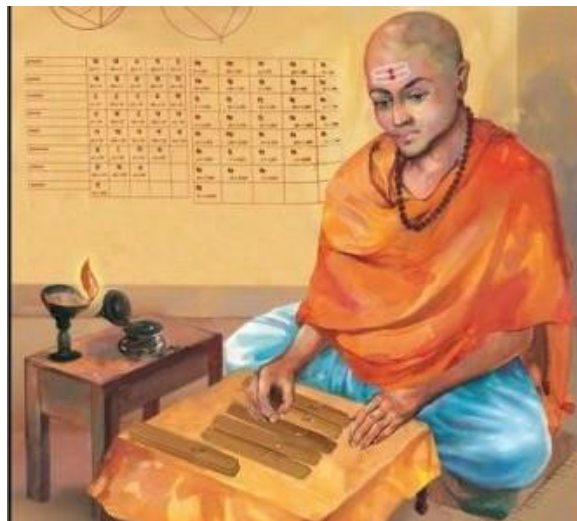
01. Aryabhatta

Aryabhatta was a great Indian mathematician and astronomer who is known for his famous invention of zero. He flourished in the Gupta era and discussed important concepts like determination of square and cube roots, arithmetic progression, quadratic, linear and indeterminate equations. He even calculated the value of pi the fourth decimal digit 1300 years before Lambert did the same. His contribution to the field of mathematics was so immense that his works were translated into Arabic and it gave rise to the Islamic Golden Age. He also discovered the important fact that the earth rotates on its own axis leading the stars to move westwards. He is also considered a physicist because he correctly identified that the luminosity of the moon and other planets are due to reflected sunlight.



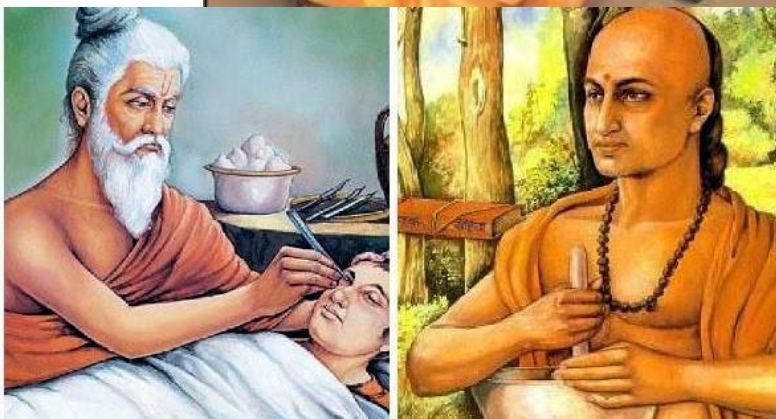
02. Brahmagupta

Brahmagupta is also a famous astronomer and mathematician who further expounded the foundations laid by Aryabhatta. He gave the world the extensive rules to compute with zero. He solved many problems in mathematics and was able to calculate the conjunctions of solar and lunar eclipses just like Aryabhatta.



03. Chara

Charaka was a great sage in Ancient India who was also a very qualified doctor and scientist. Charaka is considered the father of Ayurveda. He wrote and edited the famous medical treatise the Charaka Samhita which is the foundational text of Ayurveda. He believed and propagated the concept that prevention is better than cure on which modern medicine is founded. He paid attention to the patients surrounding and environment as



well when prescribing treatments. He also studied the anatomy of the human body in great detail and rightly considered the heart as the controlling centre of the human body. He also preached what modern doctors advise us today, that most diseases can be avoided if we practice and maintain good lifestyles.

04. Sushruta

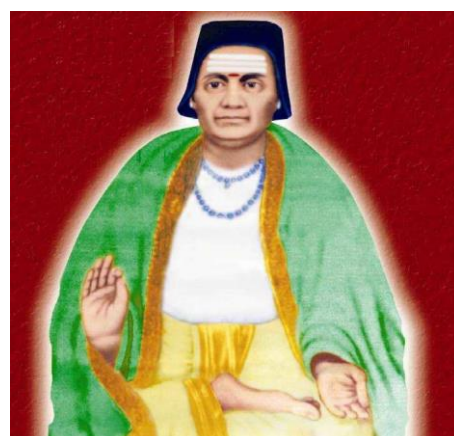
Another great scientist and surgeon is Sushruta who has written the famous Sushruta Samhita that is from Ancient India and has survived all these years. Sushruta is also called the father of surgery as he invented and developed surgical procedures. He is also the



father of plastic surgery as he invented and perfected the technique of rhinoplasty i.e. the reconstruction of the nose by using the skin from the forehead. This method has remained constant and is still used in the same way. He also conducted successful cataract surgeries. He had ground breaking ideas like classifying burns into 4 degrees a practice that is still used today, and wisely advocated the practice of mock operations on inanimate objects like watermelons, clay pots and reeds. He realised the significance of ethics in the field of medicine and proposed a code of ethics for medical practitioners, teachers and students as well.

05. Bhaskara

Bhaskara-I was the most important pupil of Aryabhata's school and a brilliant mathematician and astronomer in his own right. He was the first person known to have used the Hindu decimal system, which used the shape of 'o' (a circle) to denote the value of zero. He also wrote a commentary on Aryabhata's work and further elaborated it. The main contribution of his is that he used numbers in a positional system for mathematical applications. His contributions to the field of astronomy are well known and his treatise Mahabhaskariya contains 8 chapters dedicated to mathematical astronomy. He discusses topics related to the



“longitudes of the planets; association of the planets with each other and also with bright stars; the lunar crescent; solar and lunar eclipses; and rising and setting of the planets.”

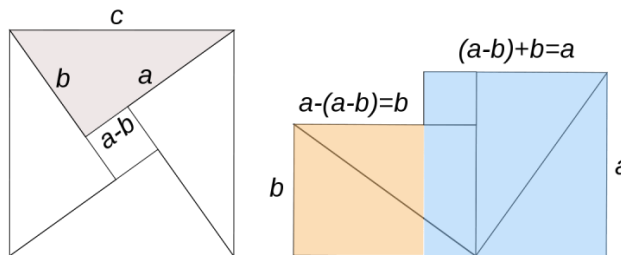
06. Varahamihira

Varahamihira was a famous scientist in Ancient India who lived and worked in modern day Madhya Pradesh. This ancient Indian astronomer and polymath composed and edited the book called Brihat Samhita which is an encyclopaedia encompassing various topics such as astronomy, planetary movements, eclipses, rainfall, clouds, architecture, growth of crops, manufacture of perfume, matrimony and domestic relations. He also improved upon the sine tables of Aryabhatta. He wrote many treatises in his lifetime that have survived through the ages and shed light on many lost works of Ancient Indian scientists who contributed immensely to the field of astronomy, physics and mathematics. He is also the first scientist to mention the shifting of the equinox around 50.32 arc seconds every year.



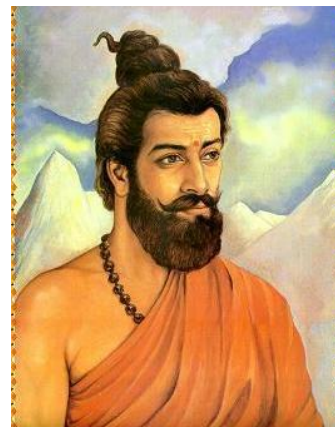
07. Bhaskara II

Bhaskara-II was a well-known scientist who was born in modern day Karnataka and was the leader of a cosmic observatory in Ujjain. The work that he did on Calculus predates Newton's and Leibniz by a long time. He further extended and developed the work of his predecessors like Aryabhatta, and Brahmagupta. He was proficient in various fields of mathematics including trigonometry, calculus, algebra, and arithmetic. He also accurately calculated the time earth takes to revolve around the sun and concluded it as 365.2588 days. The modern accepted measurement is 365.25636 days and there is a difference of 3.5 minutes only.



08. Kanada

Kanada is another great scientist of Ancient India who made some of the best discoveries in physics. He correctly theorised that the atom is spherical and went on to elucidate protons and neutrons. He also derived laws of motion which are quite similar to Newton's laws of physics. He also built the idea of atoms further by that atoms can combine with other substances forming diatomic molecules or triatomic molecules. Along with being a great scientist he also influenced Indian philosophy and various texts mention him. He founded the Vaisheshika school of Indian philosophy which represents the earliest Indian Physics.



Traditional Medicine System

Traditional medicine (also known as **indigenous** or **folk medicine**) comprises medical aspects of traditional knowledge that developed over generations within the folk beliefs of various societies, before the era of modern medicine.

The World Health Organization (WHO) defines traditional medicine as "the sum total of the knowledge, skills, and practices based on the theories, beliefs, and experiences indigenous to different cultures, whether explicable or not, used in the maintenance of health as well as in the prevention, diagnosis, improvement or treatment of physical and mental illness".

In some Asian and African countries, up to 80% of the population relies on traditional medicine for their primary health care needs. When adopted outside its traditional culture, traditional medicine is often considered a form of alternative medicine. Practices known as traditional medicines include traditional European medicine, traditional Chinese medicine, traditional Korean medicine, traditional African medicine, Ayurveda, Siddha medicine, Unani, ancient Iranian medicine, traditional Iranian medicine, medieval Islamic medicine, Muti, and Ifá. Scientific disciplines that study traditional medicine include herbalism, ethnomedicine, ethnobotany, and medical anthropology.

Ayurveda:

Ayurveda is an alternative medicine system with historical roots in the Indian subcontinent. The theory and practice of Ayurveda is pseudoscientific. Ayurveda is heavily practiced in India and Nepal, where around 80% of the population report using it.

Ayurveda therapies have varied and evolved over more than two millennia. Therapies include herbal medicines, special diets, meditation, yoga, massage, laxatives, enemas, and medical oils. Ayurvedic preparations are typically based on complex herbal compounds, minerals, and metal substances (perhaps under the influence of early Indian alchemy or *Rasashastra*). Ancient Ayurveda texts also taught surgical techniques, including rhinoplasty, kidney stone extractions, sutures, and the extraction of foreign objects.

The main classical Ayurveda texts begin with accounts of the transmission of medical knowledge from the gods to sages, and then to human physicians. Printed editions of the *Sushruta Samhita* (Sushruta's Compendium), frame the work as the teachings of *Dhanvantari*, Hindu god of Ayurveda, incarnated as King *Divodāsa* of *Varanasi*, to a group of physicians, including *Sushruta*. The oldest manuscripts of the work, however, omit this frame, ascribing the work directly to King *Divodāsa*. Through well-understood processes of modernization and globalization, Ayurveda has been adapted for Western consumption, notably by *Baba Hari Dass* in the 1970s and Maharishi Ayurveda in the 1980s.

Unani

Unani or Yunani medicine is Perso-Arabic traditional medicine as practiced in Muslim culture in South Asia and modern-day Central Asia. Unani medicine is pseudoscientific. The Indian Medical Association describes Unani practitioners who claim to practice medicine as quacks.

The term *Yūnānī* means "Greek", as the Perso-Arabic system of medicine was based on the teachings of the Greek physicians Hippocrates and Galen.

The Hellenistic origin of Unani medicine is still visible in its being based on the classical four humours: phlegm (balgham), blood (dam), yellow bile (ṣafrā) and black bile (saudā'), but it has also been influenced by Indian and Chinese traditional systems.

Unani medicine interacted with Indian Buddhist medicine at the time of Alexander's invasion of India. There was a great exchange of knowledge at that time which is visible from the similarity of the basic conceptual frames of the two systems. The medical tradition of medieval Islam was introduced to India by the 12th century with the establishment of the Delhi Sultanate and it took its own course of development during the Mughal Empire.

The Central Council of Indian Medicine (CCIM), a statutory body established in 1971 under the Department of Ayurveda, Yoga and Naturopathy, Unani, Siddha and Homoeopathy (AYUSH), monitors higher education in areas of Indian medicine including Ayurveda, Unani, and other traditional medical systems. Another subdivision of AYUSH, the Central Council for Research in Unani Medicine (CCRUM), aids and co-ordinates scientific research in the Unani system of medicine through a network of 22 nationwide research institutes and units.

Siddha

Siddha medicine is a traditional medicine originating in Southern India. It is one of the oldest systems of medicine in India and is dated to the times of 3rd millennium BCE Indus Valley civilization or earlier. According to ancient literature of Siddha, it is said that the system of this medicine originated from Hindu God Shiva who taught it to his consort Parvati. Parvati then passed it on to Nandi and Nandi taught about it to nine *Devatas*.

Though the origin of this system is considered to be divine, *Siddhar Agasthyar* is considered as the founding father of this medical system. There are 18 prominent siddhars who are the main contributors to this system of medicine. The original texts and treatise for siddha are written in Tamil language.

The Concept of siddha based on three humors of human body. When the normal equilibrium of the three humors – *Vaadham*, *Pittham* and *Kapam* – is disturbed, disease is caused. According to the basic principles of Unani the body is made up of four basic elements i.e. Earth, Air, Water, Fire which have different Temperaments i.e. Cold, Hot, Wet, Dry. They give rise, through mixing and interaction, to new entities. The body is made up of simple and complex organs. They obtain their nourishment from four humors namely- blood, phlegm, black bile and yellow bile. These humors also have their specific temperament. In the healthy state of the body there is equilibrium among the humors and the body functions in normal manner as per its own

temperament and environment. Disease occurs whenever the balance of humors is disturbed. The factors assumed to affect this equilibrium are environment, climatic conditions, diet, physical activities, and stress. Under normal conditions, the ratio between *Vaadham*, *Pittham*, and *Kapam* are 4:2:1, respectively. According to the Siddha medicine system, diet and lifestyle play a major role in health and in curing diseases. This concept of the Siddha medicine is termed as pathiyam and apathiyam, which is essentially a rule-based system with a list of "do's and don'ts".

Practicing Siddha medicine and similar forms of rural alternative medicine in India was banned in the Travancore-Cochin Medical Practitioners' Act of 1953, then reinforced in 2018 by the Supreme Court of India which stated that "A number of unqualified, untrained quacks are posing a great risk to the entire society and playing with the lives of people." The Act requires that qualified medical practitioners be trained at a recognized institution, and be registered and displayed on a list of valid physician practitioners, as published annually in The Gazette of India. The Gazette list does not recognize practitioners of Siddha medicine because they are not trained, qualified or registered as valid physicians.

In rural India, siddhars have learned methods traditionally through master-disciple relationships to become local "healers". Siddhars are among an estimated 400,000 traditional healers practicing medicine in India, comprising some 57% of rural medical care. Siddha practitioners believe that five basic elements— earth, water, fire, air, sky – are in food, "humours" of the human body, and herbal, animal or inorganic chemical compounds, such as sulfur and mercury, used as therapies for treating diseases.

Home remedies

A home remedy (sometimes also referred to as a granny cure) is a treatment to cure a disease or ailment that employs certain spices, herbs, vegetables, or other common items. Home remedies may or may not have medicinal properties that treat or cure the disease or ailment in question, as they are typically passed along by laypersons (which has been facilitated in recent years by the Internet). Many are merely used as a result of tradition or habit or because they are effective in inducing the placebo effect.

One of the more popular examples of a home remedy is the use of chicken soup to treat respiratory infections such as a cold or mild flu. Other examples of home remedies include duct tape to help with setting broken bones; duct tape or superglue to treat plantar warts; and Kogel mogel to treat sore throat. In earlier times, mothers were entrusted with all but serious remedies. Historic cookbooks are frequently full of remedies for dyspepsia, fevers, and female complaints. Components of the aloe vera plant are used to treat skin disorders. Many European liqueurs or digestifs were originally sold as medicinal remedies. In Chinese folk medicine, medicinal congees (long-cooked rice soups with herbs), foods, and soups are part of treatment practices.

Yoga

Yoga therapy is a type of therapy that draws on yoga exercises, practices, and philosophies, to improve mental and physical health. While the practice of yoga is commonly associated with

stress-relief, yoga therapy can be helpful in the treatment of several other mental health conditions as well. It may be recommended to you in combination with another type of therapy. Yoga is a complementary therapy that has been used with conventional medicine to help treat a wide range of health problems, but it does not cure any disease.

The practice of Yoga is believed to have started with the very dawn of civilization. The science of yoga has its origin thousands of years ago, long before the first religions or belief systems were born. In the yogic lore, Shiva is seen as the first yogi or Adiyogi, and the first Guru or Adi Guru.

Yogic Practices for Health and Wellness: The widely practiced Yoga Sadhanas (Practices) are: Yama, Niyama, Asana, Pranayama, Pratyahara, Dharana, Dhyana (Meditation), Samadhi /Samyama, Bandhas & Mudras, Shat-karmas, Yukta-ahara, Yukta karma, Mantra japa, etc. Yama's are restraints and Niyama's are observances. These are considered to be pre-requisites for the Yoga Sadhanas (Practices). Asanas, capable of bringing about stability of body and mind 'kuryat-tad-asanam-sthairyam...', consists in adopting various body (psycho-physical) patterns, giving ability to maintain a body position (a stable awareness of one's structural existence) for a considerable length and period of time as well.

Pranayama consists in developing awareness of one's breathing followed by willful regulation of respiration as the functional or vital basis of one's existence. It helps in developing awareness of one's mind and helps to establish control over the mind. In the initial stages, this is done by developing awareness of the 'flow of in-breath and out-breath' (svasa-prasvasa) through nostrils, mouth and other body openings, its internal and external pathways and destinations. Later, this phenomenon is modified, through regulated, controlled and monitored inhalation (svasa) leading to the awareness of the body space/s getting filled (puraka), the space/s remaining in a filled state (kumbhaka) and it's getting emptied (rechaka) during regulated, controlled and monitored exhalation (prasvasa).

Homeopathy

Homeopathy is a complementary or alternative medicine developed as traditional method of treatment unlike the modern medical science. This means that homeopathy is different from treatments that are part of conventional Western medicine in important ways. It's based on a series of ideas developed in the 1790s by a German doctor called Samuel Hahnemann.

Homeopathy is a medical system based on the belief that the body can cure itself. Those who practice it use tiny amounts of natural substances, like plants and minerals. They believe these stimulate the healing process. It was developed in the late 1700s in Germany.

A basic belief behind homeopathy is "like cures like." In other words, something that brings on symptoms in a healthy person can -- in a very small dose -- treat an illness with similar symptoms. This is meant to trigger the body's natural defenses.

For example, red onion makes your eyes water. That's why it's used in homeopathic remedies for allergies. Treatments for other ailments are made from *poison ivy*, white arsenic, crushed whole bees, and an herb called *Arnica*.

Homeopathic doctors (who also are called "homeopaths") weaken these ingredients by adding water or alcohol. Then they shake the mixture as part of a process called "potentization." They believe this step transfers the healing essence. Homeopaths also believe that the lower the dose, the more powerful the medicine. In fact, many of these remedies no longer contain any molecules of the original substance. They come in a variety of forms, like sugar pellets, liquid drops, creams, gels, and tablets.

During your appointment, a homeopath will ask a number of questions about your mental, emotional, and physical health. They'll prescribe the remedy that best matches all of your symptoms. Then they'll tailor the treatment for you.

TK and Biotechnology

Humanity always depended and still depends on the variety of animal and plants: grain and other plant raw material have been essential assets of economies for millennia. However, new biotechnologies and accomplishments in robotics brought about profound changes in the agricultural and pharmaceutical industries in recent decades and new insight into the use of plant and animal genetic resources. Whereas breeding new types of crops traditionally relied on traditional varieties and their wild relatives and on traditional breeding methods, biotechnology provides an opportunity to introduce qualities such as high tolerance for draught or extreme temperatures or anti-fungal and anti-viral resistance from unrelated species into agricultural crops. Moreover, these results can be achieved in a much shorter time than was the case with traditional breeding methods.

In pharmaceuticals, robotics increases the efficiency of screening methods, allowing for tests of smaller samples in a much shorter time and at lower cost. This makes research for natural compounds technically easier, more cost efficient, and less time consuming. This evolution brought about a new insight into use of biological resources and consequently increased interest in biogenetic and biochemical information existing in wild or domesticated species of plants, animals, or in microbes. Industry is investing large sums to create new products based on these resources, mainly in the sectors of plant breeding, pharmaceutical innovation, and industrial use.

Traditional Biotechnology

Traditional biotechnology refers to the traditional techniques of using living organisms to yield new products or modify foods or other useful products for human use. Without the traditional biotech, there won't be modern biotechnology. The early examples of biotechnology include breeding animals and crops to make cheese/yoghurt, bread, beer and wine. Some traditional techniques such as selective breeding, hybridization and mutagenesis, are used in current applications of biotechnology. Other technologies include fermentation, selective breeding, food

processing, tissue culture and more. The diversity of microorganisms and development of genetics expanded the potential of traditional biotechnology, and ultimately led to the development of modern biotechnology.

Modern Biotechnology

Modern biotechnology involves the use of GE techniques, such as recombinant DNA, functional and structural genomics, DNA diagnostic probes, and other methods for genetic modification. The development of recombinant DNA technology has marked the beginning of so-called modern biotechnology. Modern biotech has contributed significantly to enhancing our knowledge of biological systems. Modern biotechnology techniques are currently being used in many areas such as food, agriculture, forestry, healthcare, environment, minerals, and industrial processes to develop new products and processes. One of the most extensive applications of modern biotech is in agriculture. Recombinant DNA techniques and mutagenesis are used to develop plants with novel traits. Biotech diagnostics have been used to detect a wide variety of diseases and genetic conditions.

In a nutshell, biotechnology encompasses both traditional biotechnology and modern biotechnology. But without the traditional biotech, there won't be modern biotech. Traditional biotech involves use of natural organisms to create or modify food or other useful products for human use, while modern biotech involves manipulation of genes and living tissues in a controlled environment to generate new tissue. Modern biotechnology is applied in medicine and healthcare in therapeutics, mainly for the discovery, development and production of novel drugs, and in preventives for the development recombinant vaccines.

Traditional Biotechnology	Modern Biotechnology
<ul style="list-style-type: none"> • It refers to the traditional technique of using living organisms to yield new products or modify foods or other useful products for human use. • Examples of early biotechnology include recombinant DNA techniques, tissue culture and mutagenesis. • Breeding animal and crops to make cheese, yoghurt, bread beer and wine. Microorganisms are used to produce various products such as enzymes for use in laundry detergents. 	<ul style="list-style-type: none"> • The diversity of microorganisms and development of genetics expanded the potential of traditional biotech and ultimately led to the development of modern biotechnology. • Examples of modern biotechnology include DNA profiling, genome analysis, transgenesis, DNA cloning, tissue engineering, etc. • Modern biotechnology techniques are used in many areas such as food, agriculture, forestry, healthcare, environment minerals and industrial processes.

<ul style="list-style-type: none"> • It involves use of natural organisms to create or modify food or other useful products for human use. 	<ul style="list-style-type: none"> • It involves manipulation of genes and living tissues in a controlled environment.
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TK in Agriculture

The agricultural practices of indigenous people perfected over a period of time is termed as traditional ecological knowledge. Most of the farmers have been using this knowledge for making their agricultural production more yielding. Depletion of natural resource base due to deforestation, over grazing, desertification, excessive agricultural intensification, over fishing and agriculture on marginal lands leads to decline in agricultural production potential leading to decrease in the sustaining / carrying capacity of agriculture. Natural resources (soil, water, nutrients) have boundaries and improved management is needed to reverse the degradation of this resource base and develop agricultural production systems that sustain our ecosystem.

Unfortunately, the intensive and modern agriculture practices resulted in depletion of nutritional status of soils, erosion of biodiversity, natural habitats, forests and water resources. Indiscriminate use of chemical pesticides and fertilizers affected the agroecosystems, caused pollution of soil and water resulting in human and animal health hazards and contributed significantly to destabilize the traditional systems of agriculture. Whereas on the other hand, when the farmers practiced traditional integrated crop management, integrated nutrient management, organic and non-pesticidal agriculture management was observed as a sustainable practice of agriculture. The traditional practices especially regarding water management, nutrient management and pest management have been classical examples of non-exploitative and non-polluting methods of natural resources leading to sustainable agriculture.

Within farming systems, TK embraces people's knowledge of tools and techniques for the assessment, acquisition, transformation, and utilization of resources that are specific to a particular location. TK can encompass:

- ***Vernacular***: technical knowledge held by all or most individuals in a specific locality, e.g., knowledge of crop rotation, or pest and weed control;
- ***Specialized***: the technical knowledge of certain skilled 'resource persons', e.g., medicine, charcoal-making, black smithery and varietal testing;
- ***Controlled***: knowledge held by dominant groups in society, such as the specialized knowledge referred to above, or skills in animal breeding, hunting or water divining;
- ***Social***: knowledge belonging to the group (clan, caste or tribe) or community, e.g., grazing rights, fishing controls and tenure regulations.

Characteristics of traditional agriculture include:

- Extensive use of local or indigenous knowledge, spiritual, and superstitious beliefs in making agricultural decisions

- Heavy use of primitive or low-tech tools such as the axe, hoe, and stick
- Utilizing methods such as Slash & Burn and Shifting Cultivation
- Use of cattle raisin to create fallow land
- Absence of accountability or responsibility to the environment
- Lacks surplus production - only just enough is made for the farmer and their family. This is also known as subsistence farming

Traditional Farming Methods

- **Agroforestry**

Agroforestry is one of the oldest farming methods. Agroforestry involves the deliberate planting and maintaining of trees on the same plot of land as agricultural crops. This leads to the development of a unique microclimate, while also protecting the crops below. Agroforestry is successful at controlling variables such as temperature, and exposure of sunlight, wind and rain.

Thanks to agroforestry, food, timber, firewood, and staple food crops are able to all be grown and harvested on the same land. Additional benefits include extra income for farmers, improving the soil structure and quality, reducing soil erosion, sequestering carbon, and more.

In addition to the environmental benefits, agroforestry also carries strong social and economic benefits to local communities where it is carried out - for example in parts of Europe, the USA, and African countries.

- **Crop rotation**

Crop rotation is the practice of growing different crops on the same land based on the season. It helps preserve the soil productivity, reduce pests, minimize use of chemicals, maximize yields, and reduce reliance on one set of nutrients. The goal of crop rotation is to ensure positive interrelationships between cycling crops that will work together to build up soil health and fertility, and control soil erosion due to persistent root systems in the ground.

- **Intercropping**

Sowing more than two crops at the same time is also known as intercropping, or mixed cropping. Usually, intercropping is a great way of maximizing use of resources, and increasing yields and diversity of harvest on a single plot of land. There are several different types of intercropping.

It is important to note that intercropping is different compared to crop rotation. In crop rotation, different crops are grown at different times, like a relay race handing over the growth baton to each other. However in intercropping, the whole range of crops are all planted together at the same time.

Intercropping creates biodiversity, which in turn improves pest management. It also helps in fumigating the soil by increasing soil organic matter and restrain weed growth. Hence Intercropping is a local approach that is based on traditional practices which is popular even today.

- **Poly culture**

Poly culture is a system to grow many plants of different species in the same area. It increases plant biodiversity and promotes a diverse diet among local communities. The various types of poly culture are cover cropping, permaculture and integrated aquaculture.

The main advantage of poly culture is its ability to control weeds, pests and diseases without the use of chemicals. The opposite of monoculture is poly culture. It helps in reducing soil erosion and increases stable yields. It improves the quality of soil. Hence poly culture being the traditional method is still popular today across the world as it provides health and environmental **benefits**.

- **Water harvesting**

Water harvesting is one of the oldest methods around for irrigation, but also for capturing water for personal use. Usually, rainwater is collected from a roof and used on agricultural crops or stored for later personal or further agricultural use. During monsoon season, the water is collected from streams or a river which is later used by farmers in times of drought or limited rainfall. Water harvesting reduces demands on wells, and provides potable water. It is used in livestock, watering gardens and other domestic uses. It can also be used in schools, hospitals which are financed by companies or government organizations. Plus, it saves money, as it doesn't have a high costing methodology.

Traditional Societies Depend on it for their Food and Healthcare Needs

Importance of Conservation and Sustainable Development of Environment

Human existence is quite impossible without the presence of a healthy ecosystem. Our environment comprises all living and non-living components and their interactions within a natural habitat. Environmental conservation has become one of the core issues that need to be addressed to battle climate change and global warming. Sustainable development is the need of the hour that can save the mother earth from the repercussions of industrialization.

Environmental conservation is a practice that paves the way for protecting the environment and natural resources on the individual, organisational as well as governmental levels. There are various core environmental issues that are taking a heavy toll on human lives. Ranging from overpopulation, hydrological issues, ozone depletion, global warming to deforestation, desertification and pollution, all these issues pose a severe threat to the existence of humankind. Unless environmental conservation is becoming an effective mass movement, it is futile to expect positive growth especially in the age of digital media which holds the potential to bring a revolution to save our planet from destruction.

Importance of Environmental Conservation

It has become inherently important to work towards environmental conservation in contemporary times. The following pointers elucidate this crucial need to save the environment from further degradation:

- To reduce **air, water and land pollution**
- To facilitate the conservation of natural resources for our future generations
- To ensure the protection of biodiversity
- To implement **sustainable development**
- To restore the ecological balance
- To save our planet from harmful repercussions of global warming

Forest Conservation: We know that plants and trees are the essential sources of air, food as well as other day-to-day products we use. Forests are the dwelling place of different living creatures and a single disturbance in the ecosystem can cause disruption in the water cycle as well as the food chain. Thus, afforestation is amongst the core Environmental conservation and aims to plant more trees as well as save the existing ones from cutting down as trees play a crucial role in maintaining the ecological balance.

Soil Conservation: As one of the prominent methods for environmental conservation, the need for soil conservation has arisen to tackle the harmful effects of soil pollution. On earth, the soil is the main element that plays a pivotal role in soil erosion, land degradation and floods. Soil is filled with rich nutrients for plant production. Soil conservation can be carried out by ensuring minimal use of fertilizers and venomous chemicals as well as abolishing the disposal of harmful industrial waste in the soil.

Waste Management: Especially in developing countries and congested places, on a daily basis, a large amount of waste is thrown away recklessly on the streets and roads. The improper disposal of waste segregation can lead to various dreadful diseases as well as soil pollution.

Sustainable Development?

Sustainable development is the practice of developing land and construction projects in a manner that reduces their impact on the environment by allowing them to create energy efficient models of self-sufficiency. This can take the form of installing solar panels or wind generators on factory sites, using geothermal heating techniques or even participating in cap-and-trade agreements. The biggest criticism of sustainable development is that it does not do enough to conserve the environment in the present and is based on the belief that the harm done in one area of the world can be counter balanced by creating environmental protections in the other.

Ways of Conserving the Environment and sustainable development

Here are some ways of conserving the environment:

1. Deforestation must be stopped
2. Natural non-renewable resources must be utilized properly
3. Every year, we lose a huge number of forest life due to forest fire. We must find a solution to this.
4. Afforestation is the best way to conserve the environment

5. Create public awareness
6. Control pollution and population
7. Recycle goods
8. Adopt an environment-friendly lifestyle
9. Adopt waste management techniques
10. Species on the verge of extinction should be saved.

Management of Biodiversity

Biodiversity is all the different kinds of life you'll find in one area—the variety of animals, plants, fungi, and even microorganisms like bacteria that make up our natural world. Each of these species and organisms work together in ecosystems, like an intricate web, to maintain balance and support life. Biodiversity supports everything in nature that we need to survive: food, clean water, medicine, and shelter.

Why Is Biodiversity Important?

Biodiversity is important to most aspects of our lives. We value biodiversity for many reasons, some utilitarian, some intrinsic. This means we value biodiversity both for what it provides to humans, and for the value it has in its own right. Utilitarian values include the many basic needs humans obtain from biodiversity such as food, fuel, shelter, and medicine. Further, ecosystems provide crucial services such as pollination, seed dispersal, climate regulation, water purification, nutrient cycling, and control of agricultural pests. Biodiversity also holds value for potential benefits not yet recognized, such as new medicines and other possible unknown services. Biodiversity has cultural value to humans as well, for spiritual or religious reasons for instance. The intrinsic value of biodiversity refers to its inherent worth, which is independent of its value to anyone or anything else. This is more of a philosophical concept, which can be thought of as the inalienable right to exist. Finally, the value of biodiversity can also be understood through the lens of the relationships we form and strive for with each other and the rest of nature. We may value biodiversity because of how it shapes who we are, our relationships to each other, and social norms. These relational values are part of peoples' individual or collective sense of wellbeing, responsibility for, and connection with the environment. The different values placed on biodiversity are important because they can influence the conservation decisions people make every day.

How to Manage or conserve Biodiversity:

It can be conserved in the following ways:

- In-situ Conservation
- Ex-situ Conservation

In-situ Conservation

In-situ conservation of biodiversity is the conservation of species within their natural habitat. In this method, the natural ecosystem is maintained and protected.

The in-situ conservation has several advantages. Following are the important advantages of in-situ conservation:

1. It is a cost-effective and convenient method of conserving biodiversity.
2. A large number of living organisms can be conserved simultaneously.
3. Since the organisms are in a natural ecosystem, they can evolve better and can easily adjust to different environmental conditions.

Certain protected areas where in-situ conservation takes place include national parks, wildlife sanctuaries and biosphere reserves.

National Parks: *These are small reserves maintained by the government. Its boundaries are well demarcated and human activities such as grazing, forestry, habitat and cultivation are prohibited. For eg., Kanha National Park, and Bandipur National Park.*

Wildlife Sanctuaries: *These are the regions where only wild animals are found. Human activities such as timber harvesting, cultivation, collection of woods and other forest products are allowed here as long as they do not interfere with the conservation project. Also, tourists visit these places for recreation.*

Biosphere Reserves: *Biosphere reserves are multi-purpose protected areas where the wildlife, traditional lifestyle of the inhabitants and domesticated plants and animals are protected. Tourist and research activities are permitted here.*

Ex-situ Conservation

Ex-situ conservation of biodiversity involves the breeding and maintenance of endangered species in artificial ecosystems such as zoos, nurseries, botanical gardens, gene banks, etc. There is less competition for food, water and space among the organisms.

Ex-situ conservation has the following advantages:

1. The animals are provided with a longer time and breeding activity.
2. The species bred in captivity can be reintroduced in the wild.
3. Genetic techniques can be used for the preservation of endangered species.

Food Security of the Country and Protection of TK

TK plays an important role in resource management which includes agricultural and environmental manipulation. Now a days it has been largely focused on indigenous peoples and their rights, broadening the scope to agriculture, food security, renders TK an issue of interest to farming communities around the globe. Modern biotechnology in breeding of plant genetic resources may be complemented by deliberate policies to support the use and conservation of traditional plant genetic resources. TK is associated with “niche” rather than with “mass”

production. It therefore fosters diversity and contributes to the preservation of natural resources. Appropriate policies should serve the purposes of both supporting niche products, and by doing so, also of supporting biological diversity and thus food security. As scientific breeding tends to limit resources and crops available, the protection of TK in the field of agricultural plant genetic resources offers the potential of appropriate flanking policies.

Agricultural extension and research would need to accept the need TK's for innovative capacity and farming activities with modern scientific knowledge to help increase the effectiveness of TK-based farming and food production systems for the food security of the developing countries. However, the value of this material (e.g. farmers' varieties and land races, local water capture methods, companion planting practices and use of these in the modern food system) may well be completely undercut by the expansion of industrialized approaches to farming and developments in biotechnology.

The introduction of patent system in agriculture raises many controversial issues. The objection against the patent is that if the patents are allowed to stand then the indigenous populations around the world will be excluded from freely using many of the natural resources that have been carefully developed and nurtured by them for over hundreds of years. „Patenting seed“ is one of the controversial issues in the field of agriculture and food security. As we know seed is firstly linked with food and food crisis has its roots in changes in the seed supply system, and the erosion of seed diversity and seed sovereignty. This seed sovereignty includes the farmer's rights to save, breed and exchange seeds, to have access to diverse open-source seeds which can be saved and which are not patented, genetically modified, owned or controlled by emerging seed giants.

The patent protection for seed is difficult for developing countries as the livelihood of the farmers will be at stake and also fatal to them. It is because the price of patented seed will increase and the farmers could never use that seed for agriculture purpose. As a result, the natural base of the food system is likely to be superseded and the issue of food security will become more complicated.

Another critical issue is genetically modified (GM) seed. The integration and corresponding impacts pose danger to individuals and environment. There is increasing evidence from the UN and WHO that a strong causation exists between the adoption of GM seeds and environmental degradation, including deforestation. Most research shows a decrease in biodiversity with the introduction of GMOs. This means using GM seeds may actually make agricultural conditions worse than they are presently, not to mention the added threat to the health of humans, insects, and animals. The genetically modified (GM) crop which is inefficient at helping farmers or improving food security in the developing world as high economic costs associated with using industrial agricultural methods. Effectiveness of GM seeds to increase crop yield has been repeatedly refuted, along with the economic feasibility of their use.

Questions:

1. Explain how traditional knowledge is related to engineering? Illustrate contribution of Indian ancient scientists to the field of engineering.
2. What is traditional medicine? Explain the various forms of traditional medicine exists in India.
3. What do you mean by traditional biotechnology? How it is different from modern biotechnology?
4. Highlight some useful method of traditional agriculture and explain how it helps in maintaining ecological balance?
5. What is environmental conservation? Explain the importance of environment conservation?
6. What is sustainable development? How to ensure sustainable development through the use of traditional knowledge?
7. What is biodiversity? Explain the significance of preserving biodiversity?
8. What are the various methods of conservation of biodiversity?
9. Can traditional knowledge be used to ensure food security? Explain your viewpoint.