History of science and Technology:
Unit: III
Science and technology in five year Plan:

The aim of five years planning in India have been an overall development of India but as far as planning concerned with science and technology has the aim of to foster, promote and sustain the cultivation of the sciences and scientific research and to encourage individual for dissemination of scientific knowledge and above all to secure for the people of the country all benefits that accrue from the acquisition and application of scientific knowledge.

The growth and development of Science and Technology in India is not a decade or a century old activity. There is evidence which shows that it is no less than an ancient saga; the growth and development is evident through the town planning, drainage system, road planning, etc. of the Indus Valley Civilization.

Likewise, throughout from the very ancient period to the medieval or to the modern, the planning and policy of Science and Technology are the major areas of emphasis. However, after the independence, the five-year planning scheme commenced and over a period of time, Science and Technology accordingly became a major area of emphasis.

Pandit Jawaharlal Nehru, the first prime minister of India was the torchbearer who initiated by laying more emphasis on education and further led the foundation of Science and Technology.Likewise, the first policy relating to Science and Technology was first introduced in 1958.

Over the recent past, India declared the decade 2010-2020 as the "Decade of Innovation."

The Various Policies in The Field of Science and Technology

Let us now discuss the various policies implemented in the field of Science and Technology.

scientific Policy Resolution of 1958

It was the first science policy that largely emphasized on basic research in almost every field of science.

- The policy also put emphasis on developing and making available the basic infrastructure for the development of scientific research.

The Technology Policy Statement of 1983

The policy of 1983 was the second policy that largely focused on the achievement of technological competence and self-reliance.

The science and Technology Policy of 2003:

This policy brought the benefits of Science and Technology to the forefront and also focused on the investment required for research and development.

- Further, it comes with integrated programs for the socio-economic sectors with the national research and development system to address the national problems and at the same time create a national innovation system.

Science Technology & Innovation Policy 2013:

- By 2013, Science, Technology and Innovation (STI) became the major drivers of national development.
- This policy ensures faster, sustainable, and inclusive development of the people
- Further, the policy focuses on the large demographic dividend and the huge talent pool to define the role in achieving the national goals.
- The paradigm set by the policy of 2013 is **"Science technology and innovation for the people."**
- The key features of Policy 2013 are (source: Science, Technology and Innovation Policy 2013, Government of India, Ministry of Science and technology, New Delhi) −

Promoting the spread of scientific temper amongst all sections of society.

- Enhancing skill for applications of science among the young from all social strata.
- Making careers in Science, research and innovation attractive enough for talented and bright minds.

- Establishing world class infrastructure for R&D for gaining global leadership in some select frontier areas of science.
- Positioning India among the top five global scientific powers by 2020.
- Linking contributions of science, research and innovation system with the inclusive economic growth agenda and combining priorities of excellence and relevance.
- Creating an environment for enhanced Private Sector Participation in R&D
- Enabling conversion of R&D outputs into societal and commercial applications by replicating hitherto successful models as well as establishing of new PPP structures.
- Seeding S&T-based high-risk innovations through new mechanisms.
- Fostering resource-optimized, cost-effective innovations across size and technology domains.
- Triggering changes in the mindset and value systems to recognize, respect and reward performances which create wealth from S&T derived knowledge.
- Creating a robust national innovation system.

12th Five-Year Plan(2012-2017)

Besides the policies discussed above, the 12th Five-Year Plan (2012-17) focuses on the following points (of science and technology) −

- Creation and development of national facilities in the field of R&D
- Emphasis on partnership growth of Science and Technology
- Large scale investment into mega science project aimed at the creation of the research and development infrastructure in India as well as abroad (under partnership

National Council for Science & Technology Communication (NCSTC) emphasizes on the following key points −

- Promote scientific thinking.
- Promote and spread the significance of Science and Technology to masses nationally through different medium such as TV, digital media, print media, and people to people.
- Emphasise on training in Science and Technology Communication.
- Development and dissemination of Science and Technology software.
- Focus on National Children's Science Congress

II) CSIR: Mean- Council of Scientific and Industrial Research.

Purpose of CSIR:

To provide scientific industrial **research** and development that maximises the economic, environmental and societal benefit for the people of India. Industry has a wider connotation than mere manufacturing.In a recent announcement, Dr **Shekhar** C. **Mande**, the current Director of the National Centre for Cell Science (NCCS), Pune has been appointed as the new Director General of the Council of Scientific and Industrial Research (CSIR) and the Secretary of the Department of Scientific and Industrial Research (DSIR), India.

Headquarters are in New Delhi. **CSIR** maintains a large network of national laboratories and field stations and employs thousands of scientists, researchers, and support staff

The **National Chemical Laboratory** (NCL) is an **Indian government** laboratory based in **Pune in western India**

Popularly known as NCL, a constituent member of the **Council of Scientific & Industrial Research** (CSIR) India, it was established in 1950. There are approximately 200 scientific staff working here. The interdisciplinary research center has a wide research scope and specializes in polymer science, organic chemistry, catalysis, materials chemistry, chemical engineering, biochemical sciences and process development. It houses good infrastructure for measurement science and chemical information.

National Collection of Industrial Microorganisms(NCIM) is located here and is a microbial culture repository maintaining a variety of industrially important microbial culture stock.

There are about 400 graduate students pursuing research towards doctoral degree; about 50 students are awarded Ph.D. degree every year; and the young talent pool adds in every few years.

NCL publishes over 400 research papers annually in the field of chemical sciences and over 60 patents worldwide. It is a unique source of research education producing the largest number of PhDs in chemical sciences within India

This world-class research institution has a number of top professors, scientists and researchers. This well-regarded laboratory from around the world has shown strength in producing research related to a number of topics in the field of chemical science. NCL researchers are the first Indians to receive the "Merck Young Scientist Award 2019" in Chemical Sciences recently at Bangalore instituted by Merck.[1]

Popularly known as NCL, a constituent member of **the Council of Scientific & Industrial Research** (CSIR) India, it was established in 1950. There

The **Council of Scientific and Industrial Research** abbreviated as **CSIR** was established by the **Government of India** in September 1942 as an autonomous body that has emerged as the largest research and development organisation in **India**

As of 2013, it runs 38 laboratories/institutes, 39 outreach centres, 3 Innovation Centres and 5 units throughout the nation, with a collective staff of over 14,000, including a total of 4,600 scientists and 8,000 technical and support personnel.[2] Although it is mainly funded by the **Ministry of Science and Technology** it operates as an autonomous body through **the Societies Registration Act, 1860**

The research and development activities of CSIR **include aerospace engineering, structural engineering,ocean sciences life sciences, metallurgy chemicals, mining, food, petroleum, leather, and environmental science**.

CSIR-ACHIEVEMENTS:

- Developed Optical Glass at CGCR for defence purposes.
- Developed first Indian tractor ***swaraj*** in 1967 completely based on indigenous know-how.
- Achieved the first breakthrough of **flowering of bamboo** within weeks as against twenty years in nature
- With TCS, developed a versatile portable PC-based software 'Bio-Suite' for bio-informatics.
- Design of 14 seater plane 'SARAS'.
- Successfully challenged the grant of patent in the US for use of haldi (turmeric)for wound healing and neem as insecticide.

III)a) Green revolution :

The great increase in production of food grains (such as rice and wheat) due to the introduction of high-yielding varieties, to the use of pesticides, and to better management techniques. The Green Revolution was started by **Norman Borlaug** in **Mexico** in the 1940s. His success caught the attention of the world, and soon these technologies spread, helping farmers across the globe create more calories of food per acre.

The term Green Revolution refers to the renovation of agricultural practices beginning in Mexico in the 1940s. Because of its success in producing more agricultural products there, Green Revolution technologies spread worldwide in the 1950s and 1960s, significantly increasing the number of calories produced per acre of agriculture.

History and Development of the Green Revolution:

The beginnings of the Green Revolution are often attributed to Norman Borlaug, an American scientist interested in agriculture. In the 1940s, he began conducting research in Mexico and developed new disease resistance high-yield varieties of wheat. By combining Borlaug's wheat varieties with new mechanized agricultural technologies, Mexico was able to produce more wheat than was needed by its own citizens, leading to them becoming an exporter of wheat by the 1960s. Prior to the use of these varieties, the country was importing almost half of its wheat supply.

Due to the success of the Green Revolution in Mexico, its technologies spread worldwide in the 1950s and 1960s. The United States, for instance, imported about half of its wheat in the 1940s but after using Green Revolution technologies, it became self-sufficient in the 1950s and became an exporter by the 1960s.

In order to continue using Green Revolution technologies to produce more food for a growing population worldwide, the Rockefeller Foundation and the Ford Foundation, as well as many government agencies around the world funded increased research. In 1963 with the help of this funding, Mexico formed an international research institution called The International Maize and Wheat Improvement Center.

Countries all over the world, in turn, benefited from the Green Revolution work conducted by Borlaug and this research institution. India, for example, was on the brink of mass famine in the early 1960s because of its rapidly growing population. Borlaug and the Ford Foundation then implemented research there and they developed a new variety of rice, IR8, that produced more grain per plant when grown with irrigation and fertilizers. Today, India is one of the world's leading rice producers and IR8 rice usage spread throughout Asia in the decades following the rice's development in India.

Plant Technologies of the Green Revolution:

The crops developed during the Green Revolution were high yield varieties - meaning they were domesticated plants bred specifically to respond to fertilizers and produce an increased amount of grain per acre planted.

The terms often used with these plants that make them successful are harvest index, photosynthetic allocation, and insensitivity to day length. The harvest index refers to the above-ground weight of the plant. During the Green Revolution, plants that had the largest seeds were selected to create the most production possible. After selectively breeding these plants, they evolved to all have the characteristic of larger seeds. These larger seeds then created more grain yield and a heavier above ground weight.

Finally, by selectively breeding plants that were not sensitive to day length, researchers like Borlaug were able to double a crop's production because the plants were not limited to certain areas of the globe based solely on the amount of light available to them.

Impacts of the Green Revolution:

Since fertilizers are largely what made the Green Revolution possible, they forever changed agricultural practices because the high yield varieties developed during this time cannot grow successfully without the help of fertilizers.

Irrigation also played a large role in the Green Revolution and this forever changed the areas where various crops can be grown. For instance, before the Green Revolution, agriculture was severely limited to areas with a significant amount of rainfall, but by using irrigation, water can be stored and sent to drier areas, putting more land into agricultural production - thus increasing nationwide crop yields.

In addition, the development of high yield varieties meant that only a few species of say, rice started being grown. In India, for example, there were about 30,000 rice varieties prior to the Green Revolution, today there are around ten - all the most productive types. By having this increased crop homogeneity though the types were more prone to disease and pests because there were not enough varieties to fight them off. In order to protect these few varieties then, pesticide use grew as well.

Finally, the use of Green Revolution technologies exponentially increased the amount of food production worldwide. Places like India and China that once feared famine have not experienced it since implementing the use of IR8 rice and other food varieties.

Criticism of the Green Revolution

Along with the benefits gained from the Green Revolution, there have been several criticisms. The first is that the increased amount of food production has led to overpopulation worldwide. The second major criticism is that places like Africa have not significantly benefited from the Green Revolution. The major problems surrounding the use of these technologies here though are a lack of infrastructure, governmental corruption, and insecurity in nations. Despite these criticisms though, the Green Revolution has forever changed the way agriculture is conducted worldwide, benefiting the people of many nations in need of increased food production.

III)b) White Revolution in India

History: During the 1964-65, Intensive Cattle Development Programme (ICDP) was introduced in the country in which a package of improved animal husbandry was given to cattle owners for promoting the white revolution in the country. Later on to increase the speed of the white revolution, a new programme named "operation flood" was introduced in the country by the National Dairy Development Board.

The main purpose of White Revolution:
Operation Flood is the program that led to "The White Revolution." It created a national milk grid linking **producers** throughout India to consumers in over 700 towns and cities and reducing seasonal and regional price variations while ensuring that **producers** get a major share of the profit by eliminating the middlemen

The state is famous for white revolution:
The **white revolution** was started by Dr. Tribhuvan Das Patel in Anand, Gujarat in 1970. It was 'Anand Milk Union Limited' (AMUL) which was started in the city of Anand..

Features were behind the success of 'Operation Flood' in India:
(i). Adoption of new methods in the case of cattle in animal husbandry.
(ii). Changing the composition of feed ingredients in different proportions.

Achievements of the **White Revolution**

The phenomenal growth of milk production in India – from 20 million MT to 100 million MT in a span of just 40 years – has been made possible only because of the dairy cooperative movement. This has propelled India to emerge as the largest milk producing country in the World today.

Objectives of white Revolution:

Village milk producers cooperatives laid the foundation of the operation flood. With the optimum use of modern technology and management, they procured milk and provided the services.

- Creating a flood of Milk by Increase production
- Increase the incomes of the rural population
- Provide milk to consumers at fair prices

When Operation Flood was implemented Dr. Verghese Kurien- the chairman of the National Dairy Development Board. With his sheer management skills, Dr. Kurien pushed forward the cooperatives to empower the revolution. Thus, he is considered the architect of India's 'White Revolution'.

Several big corporations participated and empowered the revolution that transformed this Operation Flood in India into the White Revolution. AMUL – Anand Milk Union Limited a Gujarat based cooperation was the engine that drove the success of Operation Flood Programme.

Significance of Operation Flood:

- The White Revolution in India helped in reducing malpractice by traders and merchants. It also helped in eradicating poverty and made India the largest producer of milk and milk products.
- Operation Flood empowered the dairy farmers with control of the resource created by them. It helped them in directing their own development.
- To connect milk producers with the consumers of more than 700 cities and towns and throughout the country, a 'National Milk Grid' was formed.
- The revolution also reduced regional and seasonal price variations ensuring customer satisfaction and at the same time. Also, it ensured that the producers get a major share of the price that customers pay.
- Improved the living standards of the rural people and led to the progress of the rural economy.

Operation Flood was launched in three – phases that are discussed below:

Phase I started from 1970 and lasted for 10 years i.e. till 1980. This phase was financed by the sale of butter oil and skimmed milk powder donated by the European Union through the World Food Program.

For the successful implementation of the programme, certain aims were defined in the initial stage of Phase I. One such aim was the improvement in the marketing strategy of milk in the metropolitan cities to accomplish the goals.

Phase II lasted for five years from 1981 to 1985. During this phase, the number of milk sheds increased from 18 to 136, milk outlets were expanded to about 290 urban markets, a self-sustaining system was set up that included 4,250,000 milk producers spread across 43,000 village cooperatives. The production of domestic milk powder increased from 22,000 tons in the year 1980 to 140,000 tons by 1989, and the sale of milk also increased by several million litres a day due to direct marketing of milk by the cooperatives. All of the enhancements in production were simply because of the dairies set up under Operation Flood.

Phase III also lasted for almost 10 years i.e. 1985-1996. This phase enabled the dairy cooperatives to expand and gave a finishing touch to the programme. It also strengthens the infrastructure required to procure and market increasing volumes of milk.

Towards the end of White Revolution or Operation Flood, 73,930 dairy cooperatives had set up that links more than 3.5 crore dairy farmer members. At present, due to the White Revolution, there are several hundred Cooperations in India that are working very efficiently. Hence, the revolution is the cause of the prosperity of many Indian villages.

Knowing about the White Revolution in India, Operation Flood, NDDB, Features, objectives and significance of White revolution is important and holds relevance in various competitive exams.

III)C) Blue Revolution in India:

The Blue Revolution in India was launched during the 7th Five Year Plan (1985-1990) during the sponsorship of the Fish Farmers Development Agency (FFDA) by the Central Government of India. Later, during the 8th Five Year Plan (1992-97), the Intensive Marine Fisheries Program was launched, and eventually, the fishing harbours in Vishakhapatnam, Kochi, Tuticorin, Porbandar, and Port Blair were also established over the time.

The Ministry of Agriculture and Farmers Welfare along with the Department of Animal Husbandry, Dairying & Fisheries planned to restructure this scheme along with the other ongoing schemes by merging it under a single umbrella of 'Blue Revolution'. This scheme focused on the development and management of fisheries controlled by the National Fisheries Development Board (NFDB).

The components that are included under the Blue Revolution Schemes are :

- National Fisheries Development Board (NFDB) and its activities
- Strengthening of Database & Geographical Information System of the Fisheries Sector
- Development of Inland Fisheries and Aquaculture
- National Scheme of Welfare of Fishermen
- Development of Marine Fisheries, Infrastructure and Post-Harvest Operations
- Monitoring, Control and Surveillance (MCS) and other need-based Interventions
- Institutional Arrangement for the Fisheries Sector

Objectives of Blue Revolution:

Transforming the fisheries sector into a modern industry through the utilization of new technologies and processes.

Doubling the income of the fishers through increased productivity and improving the post-harvest marketing infrastructure including e-commerce, technologies, and global best innovators.

To ensure the active participation of the fishers and the fish farmers in income enhancement.

Tripling the export earnings by the year 2020 with a major focus on the benefits covering the institutional mechanisms.

Developing the nutritional and food security of the nation.

Features of the Blue Revolution Scheme

Providing suitable linkages and convergence with the 'Sagarmala Project' of the Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNAREGA), Ministry of Shipping, National Rural Livelihoods Mission (NRLM), Rashtriya Krishi Vikas Yojana (RKVY), etc.

The Blue Revolution scheme concentrates mainly on enhancing the production and productivity of aquaculture and fisheries both from the inland and marine sources.

Promoting and encouraging the economically backward sections like the Scheduled Castes, Scheduled Tribes, Women, and their co-operatives to take up fishing.

The Blue Revolution Scheme also encourages entrepreneurship development, private investment, Public-Private Partnership (PPP), and better leveraging of institutional finance.

Some of the major outcomes of the Blue Revolution in India are mentioned below:

1. Currently, the Indian Fisheries Sector reached a production of 4.7 million tonnes of fish from a limit of 60,000 tonnes including 1.6 million tonnes of fish from freshwater aquaculture.
2. India is recorded to achieve an average annual growth of 14.8% as compared to the global average percentage of 7.5 in the production of fish and fish products.
3. The fishery has become India's largest agricultural export over the last five years with a growth rate of 6% – 10%.
4. India has become the world's second-largest producer of fish with exports worth more than 47,000 crore rupees.
5. The fisheries and aquaculture production contributes 1% and 5% to India's GDP and Agricultural GDP respectively.