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Date: 19 February 2024

MARINE HEAT WAVES

THIS ARTICLE COVERS 'DAILY CURRENT AFFAIRS' AND THE TOPIC DETAILS OF "ARCTIC MARINE HEAT WAVES".THIS TOPIC IS RELEVANT IN THE "ENVIRONMENT" SECTION OF THE UPSC CSE EXAM.

WHY IN THE NEWS?

A new study published in the journal Nature Communications, titled **'Arctic marine heatwaves forced by greenhouse gases and triggered by abrupt sea-ice melt'**, demonstrates that unprecedented Marine Heat Waves (MHW) episodes have occurred throughout the Arctic Ocean since 2007.

KEY FINDINGS OF THE STUDY

CHARACTERISTICS OF ARCTIC MARINE HEAT WAVES (MHWS):

Between 2007 and 2021, the Arctic experienced 11 MHW events, marked by extended periods of elevated Sea Surface Temperatures (SST). These occurrences coincided with notable declines in Arctic Sea ice. The State of the Global Climate 2022 report highlighted severe and extreme marine heat waves in the Laptev and Beaufort seas from spring to autumn in 2022.

LONG-TERM TRENDS:

A distinct long-term warming trend is evident in the Arctic, **with SST increasing at a rate of 1.2°C per decade from 1996 to 2021.** The eastern Arctic marginal seas have witnessed a rise in the frequency of extreme SST events over the past two decades.

REDUCTION IN ICE COVER:

The **perpetual sea ice cover in the Arctic, known for reflecting solar radiation, has significantly diminished since the mid-1990s,** both during summer and winter. A noticeable shift occurred since 2007 from a thicker and irregular ice cover to a thinner and more uniform one. This thinner ice is less resilient, leading to quicker melting and allowing incoming solar radiation to warm the water's surface.

IMPACT OF GREENHOUSE GAS (GHG):

Marine heatwaves exceeding 1.5°C would not occur without GHGs. GHGs serve as a significant cause for moderate marine heatwaves, with a probability ranging from 66-99%.

DRIVERS BEHIND ARCTIC MHWS:

Arctic MHWs primarily manifest over marginal seas, including the Kara, Laptev, East Siberian, and Chukchi seas. These areas are characterised by shallow mixed-layer depths and predominantly first-year ice cover, conditions conducive to MHW development. **First-year ice refers to sea ice formed in a single winter season**, typically melting away entirely in the following summer melt season. The potential for abrupt sea ice retreat raises concerns as it could trigger marine heatwave events.

CONCERNS AND CONSEQUENCES:

The study issues a stark warning about the potential dramatic consequences of marine heatwaves, impacting food chains, fish stocks, and overall biodiversity.

STUDY TECHNIQUE:

The study uses the Extreme Event Attribution (EEA) technique to assess the effect of GHG forcing in Arctic MHWs. This method discerns the extent to which human-induced climate change influences the likelihood and severity of specific extreme weather events.

ABOUT MARINE HEAT WAVES

Marine Heat Waves, as per the **IPCC Sixth Assessment Report**, are characterised as periods when water temperature deviates significantly from historical temperatures for the given time of the year. This abnormal warmth persists for days to months. MHW occurs when the **sea surface temperature rises 3 or 4 degrees Celsius above the average temperature for a minimum of 5 consecutive days**. This phenomenon can occur in any oceanic location and can extend over scales of up to thousands of kilometres.

NATURAL AND ANTHROPOGENIC CAUSES OF MARINE HEAT WAVES (MHWS)

- **Climate Change:**

1. **Greenhouse Gas Emissions**: Increased levels of greenhouse gases, such as carbon dioxide, contribute to the greenhouse effect, trapping heat in the atmosphere and elevating sea surface temperatures.
2. **Global Warming**: The overall rise in global temperatures amplifies heat waves, affecting oceanic regions and giving rise to MHWs.

- **Atmospheric Conditions:**

1. **Persistent High-Pressure Systems**: Stagnant high-pressure systems can lead to prolonged periods of calm weather, allowing the sun to intensify its heat on the ocean surface.
2. **Weakening Winds**: Reduced wind speeds impede the ocean's ability to cool down, promoting the accumulation of heat.

- **Ocean Currents and Circulation:**

1. **Ocean Current Anomalies**: Changes in ocean currents, driven by natural variability or climate change, can create pockets of warmer water or impede the natural cooling process.

2. **Stalled Circulation Patterns**: Disruptions in typical ocean circulation patterns can result in the entrapment of warm water, fostering MHWs.

- **Underwater Heatwaves:**

1. **Underwater Geothermal Activity**: Submarine volcanic activity and geothermal vents release heat into the ocean, creating localised warm zones.
2. **Deep Ocean Processes**: Natural processes deep within the ocean can influence temperature variations, contributing to the onset of MHWs.

- **El Niño and La Niña Events:**
    1. **El Niño**: The periodic warming of central and eastern Pacific waters during El Niño events can have cascading effects on global weather patterns, leading to MHWs.
    2. **La Niña**: Conversely, La Niña events, characterised by cooler-than-average sea surface temperatures, can influence MHW occurrence in different ways.
- **Feedback Loops:**
    1. **Ice-Albedo Feedback**: Melting ice reduces the Earth's albedo, allowing more sunlight to be absorbed by the ocean, further increasing temperatures.
    2. **Positive Feedback Mechanisms**: Interactions between warming ocean waters, atmospheric conditions, and other factors create self-reinforcing loops, sustaining MHWs.

IMPACT OF MARINE HEAT WAVES (MHWS):

- **Ecosystem Disruption:** MHWs disrupt marine ecosystems, causing species distribution and composition shifts. Sensitive species, including corals and kelps, face bleaching and mortality.
- **Fisheries and Aquaculture:** MHWs lead to altered fish migration patterns, affecting commercial and subsistence fisheries. Aquaculture operations face economic losses due to adverse conditions.
- **Biodiversity Loss:** Increased stress on marine life leads to biodiversity loss, impacting overall ecosystem health. Vulnerable species face heightened extinction risks.
- **Coral Reefs:** Coral bleaching occurs as elevated temperatures force symbiotic algae to leave coral tissues. Prolonged MHWs result in coral mortality and degradation of reef ecosystems.
- **Economic Ramifications:** Fisheries, tourism, and coastal economies suffer as MHWs disrupt traditional livelihoods. Losses in revenue and employment opportunities exacerbate economic vulnerabilities.
- **Extreme Weather Events:** Intensified storms and hurricanes result from warmer ocean temperatures associated with MHWs. Increased risk of destructive weather events poses threats to coastal communities.

PRELIMS PRACTICE QUESTION

Q1. Which of the following statements is/are correct about the 'methane hydrate' deposits? (UPSC Prelims-2019)

1. Global warming might trigger the release of methane gas from these deposits.
2. Large 'methane hydrate deposits are found in the Arctic Tundra and under the sea floor.
3. Methane in the atmosphere oxidises to carbon dioxide after a decade or two.

Select the correct answer using the code given below.

(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 3 only

(d) 1, 2 and 3
ANSWER: (d)

MAINS PRACTICE QUESTIONS

Q1. What role do marine heat waves play in disrupting coastal tourism, and what strategies can be employed to manage and promote resilient tourism practices in affected regions sustainably?

Q2. In what ways do marine heat waves contribute to the increased intensity of extreme weather phenomena, and how can communities prepare for and adapt to the heightened risks associated with these events?

Himanshu Mishra

THE AGE OF ARTIFICIAL INTELLIGENCE (AI) : VERSUS RECALIBRATING COMPETENCY

SOURCE – THE HINDU AND PIB.

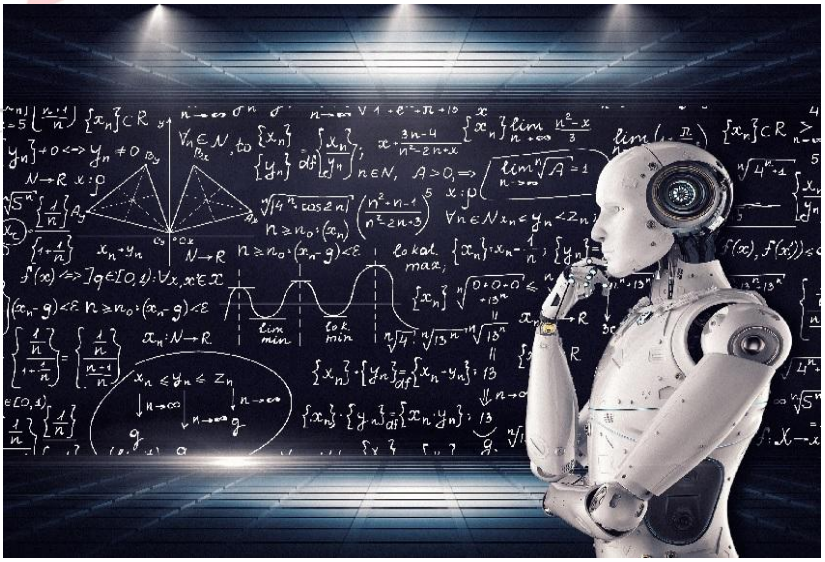
GENERAL STUDIES – SCIENCE AND TECHNOLOGY, ARTIFICIAL INTELLIGENCE, MERIT SYSTEM, IMPROVING THE COUNTRY'S ECONOMY, NITI AAYOG, SUSTAINABLE DEVELOPMENT GOALS.

WHY IN THE NEWS ?

- The concept of meritocracy, in which individuals are rewarded and promoted based on their abilities, achievements and hard work rather than on their social status or their family, ethnic, gender, racial or social background, has recently become popular among policy makers across the globe. Is extended, but there has been a very large and detailed debate. Proponents and critics of meritocracy have argued about its effects on society, highlighting its merits and shortcomings. Influenced by the criticisms and analyzes of thinkers such as British sociologists Michael Young, Michael Sandel and Adrian Wooldridge, significant changes are being seen in the development of meritocracy all over the world.

- British sociologist Michael Young in his satirical book '**The Rise of the Meritocracy (1958)** predicted a dystopian meritocratic world.
- He envisioned a future by 2034, as a society where social class and mobility were determined entirely by intelligence and effort, as measured through standardized testing and educational achievement. This was a criticism of the then emerging trend towards a merit-based system, which he feared would lead to a new form of social stratification.
- Artificial intelligence technology is a special branch that studies giving machines the ability to function with intelligence.
- Under this branch, various techniques are studied to enable machines to learn on their own and develop the ability to solve problems.
- The main objective of artificial intelligence technology is to provide machines with the ability to take actions with the same intelligence as humans.
- Artificial intelligence technology includes many sub-branches which are adopted in different fields.
- Machine learning is a technology in which machines learn and take decisions on their own from the data fed into them.
- Deep learning provides machines with the ability to learn directly on their own rather than using a multi-system approach. In robotics technology, machines are given the ability to perform physical actions. Peripheral technology and the Internet of Things study devices embedded in the human body and the technologies to connect them to the Internet.
- By combining these techniques, artificial intelligence technology is finding application in many fields. These technologies are being used to make human life simpler and safer. For example – robots for sanitation, automated vehicles, and artificial intelligence are being used in health services.
- Thus, artificial intelligence technology is ushering in a new era in which machines are working together with humans to make human life even more convenient.

INTRODUCTION TO ARTIFICIAL INTELLIGENCE TECHNOLOGY :



- Artificial Intelligence (AI) is a field that is bringing unprecedented changes in the areas of technological and scientific advancement. In this, machines are made to feel intelligent, so that

they can perform assigned tasks independently. This, along with new technologies, is creating new challenging contexts that require new definitions and standards of competency.

- The main objective of the National Strategy for Artificial Intelligence (AI) released by Niti Aayog is to ensure effective access of AI to all people and to empower them to develop technical capabilities. To be made capable.

OBJECTIVE OF THE NATIONAL STRATEGY RELATED TO ARTIFICIAL INTELLIGENCE ANNOUNCED BY NITI AAYOG :

- This national strategy aims to address and promote the lack of skilled expertise in the field of artificial intelligence in India. NITI Aayog also believes that the disproportionate challenges in the field of artificial intelligence should be addressed to enhance and empower human capabilities.
- The main objective of this National Strategy of NITI Aayog is to effectively implement various initiatives in the field of Artificial Intelligence, develop solutions for emerging economies through their effective implementation, promote research and thereby accelerate economic development activities. have to give.
- The objective of this national strategy announced by NITI Aayog is to tackle not only national level challenges but also global level challenges through AI.
- Under this National Strategy, the objectives related to Artificial Intelligence in India include extending the technological benefits to all through mutual cooperation and partnerships in this field, so that all-round prosperity can be achieved.
- The objectives of the National Strategy for Artificial Intelligence announced by NITI Aayog also include #Al for All (#AI for All) i.e. opening the doors of artificial intelligence to all people and encouraging them to use it.

To promote artificial intelligence in India, NITI Aayog has set out three main components that will work towards the 'Greater Good'. These three components are as follows –

ARTIFICIAL INTELLIGENCE FOR GREATER GOOD FOR SOCIAL AND INCLUSIVE DEVELOPMENT :

- Through this component, efforts are being made to rapidly promote the process of social development and inclusive growth. This includes improving the quality of life, equality of access for people, and social inclusion in prosperity.

USEFULNESS AND OPPORTUNITIES OF ARTIFICIAL INTELLIGENCE IN THE ECONOMIC SECTOR FOR INDIA :

- Under this component, high-growth technological and intelligence opportunities are being harnessed to promote the utility of Artificial Intelligence in the Indian economic sector.

'ARTIFICIAL INTELLIGENCE GARAGE' FOR 40% OF THE WORLD'S PEOPLE :

- Through this component, India is working to develop its artificial intelligence with an aim to share it with the people of the world and create an 'Artificial Intelligence Garage' globally.
- Through these three components, NITI Aayog has attempted to work in the most critical areas to enhance the country's artificial intelligence at the social, economic, and global levels. This will not only lead to development in India, but will also contribute to world prosperity.

This could provide an opportunity for India to use artificial intelligence in many ways in the economic sector. NITI Aayog has considered it a part of the national strategy and has accepted it as an important tool for economic development.

1. **Increase in production:** Increase in the area of production in India through artificial intelligence technology will lead to growth in the economic sector. This could provide an opportunity to innovate and produce at a faster pace, leading to entry of new products and services into the Indian market.
2. **Industrial Development:** Artificial intelligence technology can encourage innovations in the industrial sector. This will not only increase productivity, but will also promote economic growth.
3. **Improvement in the service sector:** Artificial intelligence can also improve the service sector. This will speed up delivery of services and improve quality.
4. **Accelerating economic growth:** The use of artificial intelligence can accelerate economic growth. According to NITI Aayog, this technology can increase India's growth rate.
5. **Solution to the problems of the world economy:** This use of India can provide an ideal arena for enterprises and institutions across the world to find scalable solutions to various problems. This can help in improving the world economy.
6. **Research towards factors of climate change:** With the help of artificial intelligence technology, factors of climate change can be researched, which are important in the field of agriculture. This can provide useful technical solutions for India as well as other developing countries of the world.

In the discussion of sectors selected by NITI Aayog under the National Strategy for Artificial Intelligence in India, NITI Aayog has chosen five sectors namely education and skills sector, agriculture sector, health sector, smart mobility and transportation, smart cities and infrastructure. The aim is to promote development in these areas through artificial intelligence technology.

- NITI Aayog has also taken many initiatives in this direction. For example –**Organization of 'Responsible Artificial Intelligence for Social Empowerment 2020' (RAISE 2020) Summit, launch of 'Responsible Artificial Intelligence Program for Youth', and launch of 'US India Artificial Intelligence Initiative' (USIAI) with the United States.** etc Apart from this, India has also made several plans at the global level by joining the 'Global Partnership on Artificial Intelligence' (GPAI) group.
- Along with this, Indian institutions have also contributed in the discovery and development of various technological advancements in the field of 'Artificial Intelligence' in India. In this **Chatbot 'AskDisha' developed by a branch of Indian Railways, 'Artificial Leaf' developed by researchers at the Indian Institute of Science and Serpent robot developed by the Indian Defense Research and Development Organization (DRDO)** Examples include. Through these initiatives, India is moving towards independence and social development and is playing an important role in the field of artificial intelligence.

The promotion of Artificial Intelligence is being guided by the National Strategy of five areas selected by NITI Aayog. These five areas are considered to have the highest potential for development, and artificial intelligence technology has an important place in it. The selection of these five areas is as follows –

1. **Education and Skills Sector:** It involves modernizing India's education system through applications of artificial intelligence technology in education and exposing students to new technologies.
2. **Agricultural sector :** artificial intelligence technology in indiaInvolves improving productivity and quality in the agricultural sector by using cutting edge technological measures.
3. **Health sector :** The medical or public health sector in India involves improving the diagnosis and treatment of diseases by using new techniques of artificial intelligence technology.
4. **Smart Mobility and Transportation:** By using artificial intelligence in the transport sector of India, the transport sector can be integrated and made smart.
5. **Smart cities and infrastructure:** Urban development in India involves improving the design of smart cities by making maximum use of artificial intelligence technology and pursuing new and safer technologies in infrastructure.

ARTIFICIAL INTELLIGENCE TECHNOLOGY AND INDIA :

- India is the second most populous country in the world. Therefore, in India, apart from having many types of problems, their quantity is also increasing and the complications related to it are also there. In such a situation, artificial intelligence technology can provide an important solution for India. Policy makers and experts believe that the development of artificial intelligence can transform India into a model region. Therefore, the Government of India should try to promote more and more research in this field.
- NITI Aayog has analyzed India's potential based on artificial intelligence technology and studied that if used properly, it can add about $1 trillion to India's economy by 2035. According to this survey, India still has great potential for the development of artificial intelligence technology, but there are some shortcomings in its development at present.
- According to a report, if artificial intelligence technology is used properly in India, it can contribute about 3 percent to the country's economic growth by the year 2035. Therefore, NITI Aayog has stressed the need to encourage more research in this area.
- Artificial Intelligence technology can be helpful in bringing a positive change for India, and the government needs to take more steps in this direction.

CHALLENGES AND SOLUTIONS BEFORE INDIA IN THE DEVELOPMENT OF ARTIFICIAL INTELLIGENCE TECHNOLOGY :

1. **Population and education :** Despite the large population in India, there is development in the education sector, but there is a need to integrate it in technical education in a better way. Artificial intelligence technology should be included as a major tool in education so that students have increased interest and understanding in it.
2. **Investment and Research:** The development of artificial intelligence technology requires more investment and research. The government and the private sector should be encouraged to invest together so that new technologies can be studied and developed.
3. **Social and Ethical Issues :** In India it is important to take into account ethical and social issues in the use of artificial intelligence technology. High ethical standards must be followed to support and ensure that this technological development is accompanied by social change.
4. **foreign investment :** India needs foreign investment in artificial intelligence technology. India can also motivate foreign companies to invest in this sector so that the pace of India's technological development increases.
5. **Solution to unemployment :** The development of artificial intelligence technology can also create new employment opportunities in India. It should work with the government and the private sector to help reduce unemployment.
6. **Environmental effect :** Environmental impacts must be taken into account when developing artificial intelligence technology. It should lead to minimization of the impact of products and processes to make them compatible with the environment.

DISADVANTAGES OF ARTIFICIAL INTELLIGENCE TECHNOLOGY IN INDIA :

1. **Requirement of large amounts of data:** Using artificial intelligence technology requires large amounts of data, and if there is a lack of data, it can impact technical performance.
2. **Increase in energy consumption:** Devices based on artificial intelligence technology can consume more energy, especially requiring more energy to cool them.
3. **Environmental effect :** The increase in chemical waste and carbon footprint resulting from the use of artificial intelligence technology can be harmful to the environment.
4. **Possibility of violation of privacy:** Big data collection arising from artificial intelligence technology may increase the risk to individual privacy. Which can also be seen as a violation of a person's privacy.
5. **Possibility of cyber attacks and fraud:** The potential for cyber attacks and fraud through artificial intelligence technology may increase, leading to new challenges in cyber security.
6. **Increase in economic inequality :** With the use of artificial intelligence technology, developed countries are becoming more capable, while developing and poor countries are lagging behind in it, which may increase economic inequality.
7. **Data localization issue:** Data localization efforts can also be a challenge for artificial intelligence technology companies, causing higher costs and greater difficulty in controlling them.

Despite these disadvantages, it is important that ethics, security, and governance systems are strengthened when interpreting artificial intelligence technology so that it can be used for social and economic improvement.

RELATIONSHIP BETWEEN ARTIFICIAL INTELLIGENCE AND ABILITY :

Artificial intelligence technology is developing rapidly and has rapidly increased the demand for unique abilities in many fields. Technologies like machine learning, neural networks, deep learning, and natural language processing are helping to increase efficiency. Through these techniques, artificial intelligence technology systems can learn on their own and even correct their errors. Additionally, artificial intelligence technologies can accept new information, thereby improving efficiency.

- Defense Research and Development Organization (DRDO): DRDO has made many important efforts in the field of artificial intelligence technology for the Indian Army. This includes the supercomputing systems developed by them, robotics, high security equipment, and security systems based on artificial intelligence.
- National Strategy of NITI Aayog: NITI Aayog has announced 'A National Strategy on Artificial Intelligence' in 2018, in which it outlines ways to use artificial intelligence to boost Indian potential.
- Other Institutions: Various institutions in India such as the Indian Space Research Organization (ISRO), Indian Institutes of Technology (IITs), and other research institutions are also studying and researching the latest technology in the field of artificial intelligence.
- Liberalization: NITI Aayog has also raised the issue of promoting global cooperation and liberalization in its strategy. With this, India can gain the ability to progress globally.

Through these efforts, India is moving ahead in the field of artificial intelligence technology and is also playing an important role at the global level.

WAYS TO REORGANIZE COMPETENCY IN THE ERA OF ARTIFICIAL INTELLIGENCE:

1. **Following new systems in education:** In the age of artificial intelligence, it is important to pursue new systems in education. In this, Artificial Intelligence can be used to give individual attention to the students and develop their abilities.
2. **Development of human-machine companion:** To organize competence in the era of artificial intelligence, it is necessary to develop a human-machine partner. This can help the employees to utilize their abilities properly and improve their qualifications.
3. **Competency based learning :** Artificial intelligence can be used for competency based learning. This can ensure that training programs and learning processes firmly maintain competency.
4. **Focus on health and mental health :** Artificial intelligence can be used to enhance competency in the fields of health and mental health. It can help provide personalized health suggestions through neural networks, helping people stay healthy.
5. **Establishment of standards of qualification :** In the age of artificial intelligence, it is important to establish standards of competency in various fields. These standards will determine whether there is evidence of improvement in the competency of individuals and organizations and will provide a sustainable way of measuring competency.

6. **Ethical and safe use:** It is extremely important to use artificial intelligence in an ethical and safe manner. It should be ensured that it is used carefully for enhancing competency and does not give rise to any social or ethical problems.

CONCLUSION / PATH TO SOLUTION :

- Artificial Intelligence Reorganizing meritocracy in the age of 1980 is a socially, economically, and technologically important issue. By using it in the right direction and in the right way, we can move towards an advanced, powerful, excellent and prosperous society.
- The possibilities hidden in artificial intelligence technology can have more positive impacts than challenges. Therefore, all communities in the world should together strive to promote artificial intelligence technology and use it towards global well-being and human welfare.
- To move ahead in the field of artificial intelligence, a generous spirit and dedication is required, so that the challenges coming from this technology can be eliminated and human society can be helped in getting benefits from it.
- Looking at India's progress in the field of artificial intelligence, it appears that the country has taken significant steps in this field and is poised to take it forward. India should invest more in research and development, so that the real benefits of this technology can be reaped.
- India will also be able to achieve its sustainable development goals by getting real benefits from artificial intelligence technology and making maximum use of it, due to which artificial intelligence technology can play an important role in India's prosperity and progress.

PRACTICE QUESTIONS FOR PRELIMINARY EXAM :

Q.1. Consider the following statements regarding measures to realign merit in the age of artificial intelligence.

1. In the age of artificial intelligence, it is important to pursue new systems in education.
2. To organize competence in the era of artificial intelligence, it is necessary to develop a human-machine partner.
3. Artificial intelligence can be used to enhance competency in the fields of health and mental health.
4. The use of artificial intelligence technology can also be seen as an invasion of an individual's privacy.

Which of the above statement / statements is/are correct?

(A) Only 1 and 3
(B) Only 2 and 4
(C) None of these.
(D) All of these.

Answer – (D)

PRACTICE QUESTIONS FOR MAIN EXAM :

Q.1. What do you understand about artificial intelligence technology? In front of a developing country like India Discuss in detail the challenges arising in the development of artificial intelligence technology and its solutions.

Akhilesh kumar shrivastav