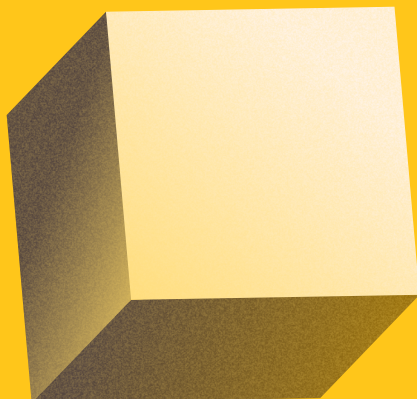


# THE HINDU ANALYSIS

**26th March 2024**  
by saurabh pandey

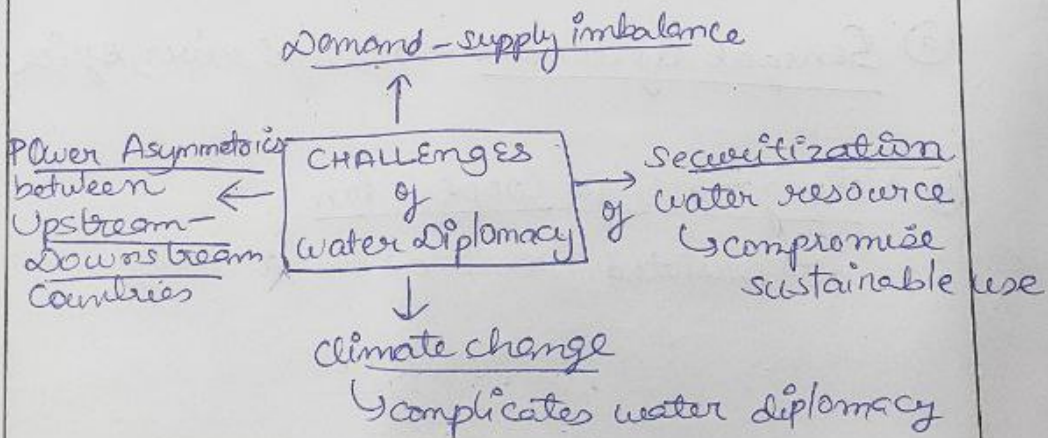


Q 66 "Water diplomacy is way forward in maintaining relationship between countries in the era of Anthropocene." Discuss. (15M)

Water diplomacy refers to use of diplomatic instruments to solve disagreements over shared water resources.

### Need for water Diplomacy

- 1) Water scarcity & stress → Acc. to World Resources Institute, 17 countries extremely high water stress
- 2) Anthropocene era Climate change → oratic Indian Monsoon
- 3) Transboundary water conflicts
- 4) SDG 6 → Sustainable water management by 2030
- 5) International Water Law → water cooperation



# U.P.S.C.

प्रश्न संख्या  
(Question No.)

इस भाग  
में  
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in this)

## Significance of Water Diplomacy ↳ As a way forward

- ① Water Diplomacy → Instrument for world Peace  
'Water for Peace' → Theme for world water day '24
- ② Fosters cooperation
- ③ Fulfills SDG 6 by 2030
- ④ Ensures water security
- ⑤ Conflict resolution
- ⑥ Regional Integration

## Examples of water diplomacy

- ① Indus Water Treaty → between India + Pak
- ② Mekong Agreement → for Mekong river Basin
- ③ Senegal Agreement → Senegal river, Africa
- ④ Mekong - Ganga Cooperation  
↳ persisted even Indo China war

# U.P.S.C.

## WAY FORWARD :

- ① Science based water diplomacy :-  
eg:- USA - Canada border water management
- ② Women participation & leadership :-  
eg:- women in water diplomacy - Nile
- ③ Cross border water governance
- ④ Multi stakeholders → different interest  
↳ arbitration & mediation
- ⑤ Strengthen existing frameworks :-  
eg:- International water law
- ⑥ Water Education & Innovation :-  
circular water economy, awareness,  
IoT based systems.

Thus in this anthropocene era, water diplomacy has acted as a way forward & 'water for peace' emphasises the consistent need of water diplomacy as a way forward.

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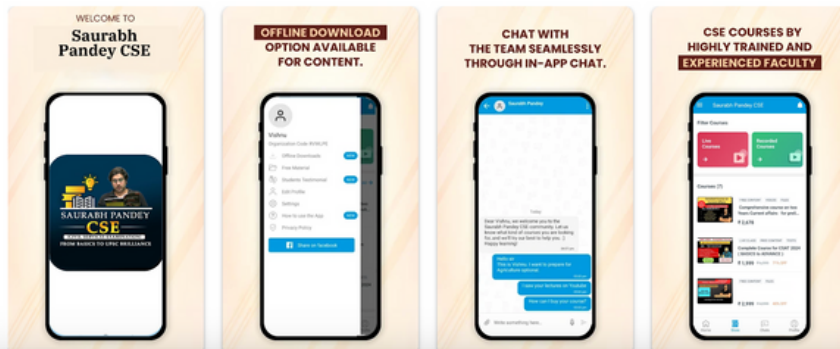
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The screenshot shows the homepage of saurabhpandeyupsc.com. At the top, there is a navigation bar with a logo for 'SAURABH PANDEY CSE' and a search bar. Below the navigation bar, there are menu items for 'Home', 'Courses', 'Pages', 'More', 'About UPSC Exam', 'Current-Affairs Pointers', and 'Join Us'. A 'Get Started' button is also visible. The main section is titled 'Popular Courses' and features four course cards:

- Agriculture For General Studies**: A Prelims Module course, 'LAUNCHED', for 'Target Prelims 2024'. It covers 'Basics and current affairs' and 'Agriculture for General studies'. The instructor is 'BY Saurabh pandey sir'.
- International Relations (Basic And Current...)**: A Prelims Module course, 'LAUNCHED', for 'Target Prelims 2024'. It covers 'Basics and current affairs' and 'International Relations'. The instructor is 'BY Saurabh pandey sir'.
- Science And Technology For Prelims (Basic +...)**: A Prelims Module course, 'Launched', for 'Target Prelims 2024'. It is a 'Course on Advance Topics of Science & technology'. It covers 'Topics from last 2 yrs' and 'Special focus on Newspapers especially the hindu'. The instructor is 'BY Saurabh pandey sir'.
- Comprehensive Course On Two Years Current...**: A Prelims Module course, '2 YRS COVERAGE', for 'ALL SUBJECTS!!'. It covers '-POLITY', '-ECONOMY', '-GEOGRAPHY AND ENVIRONMENT', '-SCIENCE AND TECH', and '-INTERNATIONAL RELATION ETC'. The instructor is 'BY Saurabh pandey sir'.

Each course card includes a brief description: 'Are you preparing for the UPSC Mains examination, and GS Paper 2 -...'.

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# Why does the weakness of low durability dog newer vaccines?

Not all vaccines prompt the body to make B cells. Some require boosters to enhance the duration of immunity, ranging from six months to a few years. Also, vaccines trigger production of memory B cells to different degrees, even as having memory B cells alone doesn't guarantee protection

Vipin M. Vashishtha  
 Puneet Kumar

Once an individual has received a measles jab, they are usually considered protected against measles disease for their entire life. The measles vaccine is one of the most potent vaccines in our armamentarium today. But this is not the case with most other vaccines. One needs to take several boosters for a long protection. Why is this the case?

In a recently published review of 34 currently licensed vaccines for the duration of their protective immunity, it was found that only five vaccines provide long-lasting protection spanning more than 20 years and only three provide lifelong protection. Of these 34 vaccines, 15 provide 5-20 years of protection, whereas a similar number of other shots offer short-term protection that lasts around five years or less.

More importantly, barring a very few, most of the new-generation vaccines have a short duration of protection.

## Different immune responses

Post-vaccination immunity develops in a complex process. In the fundamental immunological mechanism, our lymph nodes first produce the memory B cells that confer long-term protection against disease.

These cells 'memorise' the antigen the vaccine has delivered. In future, when a foreign object like a virus enters the body bearing the same antigen, the B cells will trigger the production of a large number of potent antibodies to destroy it, removing the infection.

These memory B cells require T cell support, and only vaccines that stimulate T cells can also induce the body to produce them.

Further, not all vaccines - including the polysaccharide typhoid and the pneumococcal vaccines - prompt the body to make B cells.

In some cases, frequent boosters are required to enhance the duration of immunity the cells confer, ranging from six months to a few years. Also, vaccines trigger the production of memory B cells to different degrees, plus having memory B cells alone does not guarantee protection.

Following the administration of the measles and the rubella vaccines, the level of memory B cells in the blood plasma remains constant.

It corresponds well with antibody levels decades later. This is not the case with the chickenpox, tetanus, and diphtheria vaccines - suggesting that memory B-cell persistence may not ensure antibody durability and that another mechanism may be involved in sustaining antibody levels.

Another essential immune cell, called long-lasting plasma cell (LLPC), migrates from the lymph node to the bone marrow and may endure for decades. LLPCs are the main immunological factor in vaccine-induced immunity. Every vaccine tries to create long-lasting plasma cells for lifelong protection, a.k.a. the immunology 'holy grail'.

The measles and rubella vaccines produce these cells in the bone marrow. However, some potent vaccines, such as the mRNA COVID-19 shots, fail to activate these cells in the bone marrow.

To provide long-term protection, then,



The genetic stability of the virus contained in a vaccine also influences the durability of immunity. MUFID MAJUN/UNSPASH

vaccines must generate memory B cells and LLPCs in the bone marrow.

Different vaccines differ in their ability to produce these cells, explaining the disparity in their durabilities.

## Explaining the disparity in durability

There are three main categories of factors responsible: vaccine-related, target pathogen-related, and host-related.

Live viral vaccinations - including the vaccines for measles, rubella, yellow fever, chickenpox, and polio (oral) - provide longer lasting protection than killed pathogen or subunit vaccines. Newer platforms like 'virus-like particle' (VLP) also offer long-term protection. The HPV vaccines were developed using this platform.

Next, the proper interval between doses of a multi-dose vaccine, like that for hepatitis B, matters. A long interval of at least six months between the priming and the booster doses is essential for adequately processing the antigen and a robust, durable immune response.

Adding adjuvants to vaccines also significantly affects vaccine-induced immune responses and their persistence. Some novel adjuvants, like TLR agonists, can directly influence memory B cell functions as well.

The durability of vaccine-induced protection also depends on the characteristics of the respective pathogens. Viruses that quickly infect the body (shorter incubation period) don't give enough time for the immune system to respond effectively. Examples include the influenza and the SARS-CoV-2 viruses. Whether it is a natural infection or vaccine-induced, the resulting immunity is not long-standing.

The converse is also true: infections or vaccines against viruses like mumps,



As the mechanisms of immune response durability become more apparent, we can construct vaccines strategically to provide durable vaccine-induced protection with fewer doses

measles, and yellow fever, with extended incubation periods, lead to durable immunity since the immune system has more time to respond.

Further, pathogens that cause only mucosal infections but minimal blood infection, like SARS-CoV-2, influenza, and the respiratory syncytial virus, pass from one person to another in a short span, before our immune system has had the time to launch an immune response. This is the reason why reinfections are frequent with these viruses.

The genetic stability of the virus contained in a vaccine also influences the durability of immunity. We know RNA viruses are known for their high mutation rates. (Both measles and SARS-CoV-2 are single-stranded RNA viruses.) While we still use the same strain of measles vaccine isolated from the throat of David Edmonston in 1954, the SARS-CoV-2 vaccines have been updated thrice in the last four years.

This is also why the flu vaccines need to be revised twice a year. The measles virus' surface glycoprotein is more resistant to ongoing mutations. On the other hand, only a handful of mutations at the spike protein change the antigenic nature of the SARS-CoV-2 virus.

Next, host-related factors affect durability. The individual's age at the time of vaccination influences the persistence

of vaccine-induced antibodies: the response is shorter at both extremes of age because of immaturity and senescence of the immune system, respectively.

Immune responses may also vary with gender. Studies have found that biologically female bodies elicit more exuberant immune responses to infections than males. Recent studies have also found obesity may accelerate the waning of vaccine efficacy.

The time of day a vaccine is given also affects the immune response's robustness. Shots in the morning have been demonstrated to confer better immunological responses than those later in the day. The circadian clock affects immune-cell processes like cytokine generation, cell trafficking, dendritic cell activity, and T and B cell activity. Studies in mice have found a good night's sleep may also boost the immunological interactions and provide enduring protection.

New bioengineering technologies are evolving rapidly. With nanoparticles and virus-like particle vaccinations, antigen valence and density are finely regulated. Antigen delivery can be controlled and sustained via newer biomaterials. New adjuvants can activate specific innate immune pathways. As the mechanisms of immune response durability become more apparent, we can construct vaccines strategically to provide durable vaccine-induced protection with fewer doses.

(Dr. Vipin M. Vashishtha is past convener, IAP Committee on Immunisation, and director and paediatrician, Mangla Hospital and Research Centre, Bijnor. Dr. Puneet Kumar is a clinician, Kumar Child Clinic, New Delhi, with a special interest in infectious diseases and vaccination.)





# Vaccine and Immunity

- **Post-vaccination immunity develops in a complex process.**
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- **These cells ‘memorise’ the antigen the vaccine has delivered. In future, when a foreign object like a virus enters the body bearing the same antigen, the B cells will trigger the production of a large number of potent antibodies to destroy it, removing the infection.**
- **These memory B cells require T cell support, and only vaccines that stimulate T cells can also induce the body to produce them.**



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- Also, vaccines trigger the production of memory B cells to different degrees, plus having memory B cells alone does not guarantee protection.



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A sun-baked pool that used to be a perennial water supply in Mana Pools National Park, Zimbabwe. TSUNGRAYI MUKWAZHU/AP

## *El Nino impact leaves Malawi and region on the edge of a hunger crisis*

**Press Trust of India**

The southern African nation of Malawi has declared a state of disaster caused by drought in 23 of its 28 districts. Its president has also said Malawi urgently needs more than \$200 million in humanitarian assistance, less than a month after neighbouring Zambia also appealed for help.

A third country, Zimbabwe, has also seen much of its crops decimated and is considering following suit and declaring a drought disaster, underscoring concerns raised by the U.N. World Food Programme (WFP) late last year that numerous nations in southern Africa were on the brink of a hunger crisis because of the impact of the ongoing El Niño weather phenomenon.

The WFP said there were already nearly 50 million people in southern and parts of central Africa facing food insecurity even before one of the driest spells in decades hit.

Last month was the driest February in 40 years for Zambia and Zimbabwe, according to the WFP's seasonal monitor while Malawi, Mozambique, and parts of Angola had "severe rainfall deficits." Millions in southern Africa rely on the food they grow to survive. Corn, the region's staple food, has been badly affected by the drought.

**The WFP said there were nearly 50 million people in southern and central Africa facing food insecurity even before the driest spells in decades hit**

El Niño is a natural, recurring weather phenomenon that affects weather worldwide, including causing below-average rainfall in southern Africa. Some scientists say climate change is making El Niños stronger and their impacts more extreme. The 2015-2016 El Niño brought a severe drought to southern Africa, the region's worst in 35 years, for example.

Before the national disaster announcements by Malawi and Zambia, the WFP and USAID had already launched a programme to feed 2.7 million people in rural Zimbabwe facing food shortages – nearly 20% of that country's population.

British charity Oxfam said this month that more than 6 million people in Zambia – 30% of its population – are now facing acute food shortages and malnutrition, with the next crop growing season a year away.

Malawian President Lazarus Chakwera said he had been on a tour of his country to discover the extent of its drought crisis, and a preliminary assessment by the government found about 44% of Malawi's corn crop had failed or been affected, and 2 million households were directly impacted. Malawi has been repeatedly hit by weather extremes in recent years.

In early 2022, tropical storms and floods contributed to Malawi's worst outbreak of the water-borne disease, cholera. More than 1,200 people died in the outbreak that lasted for months, according to the World Health Organisation.

Zambia is also currently experiencing a major cholera outbreak as well.



**The hindu analysis by saurabh pandey sir**



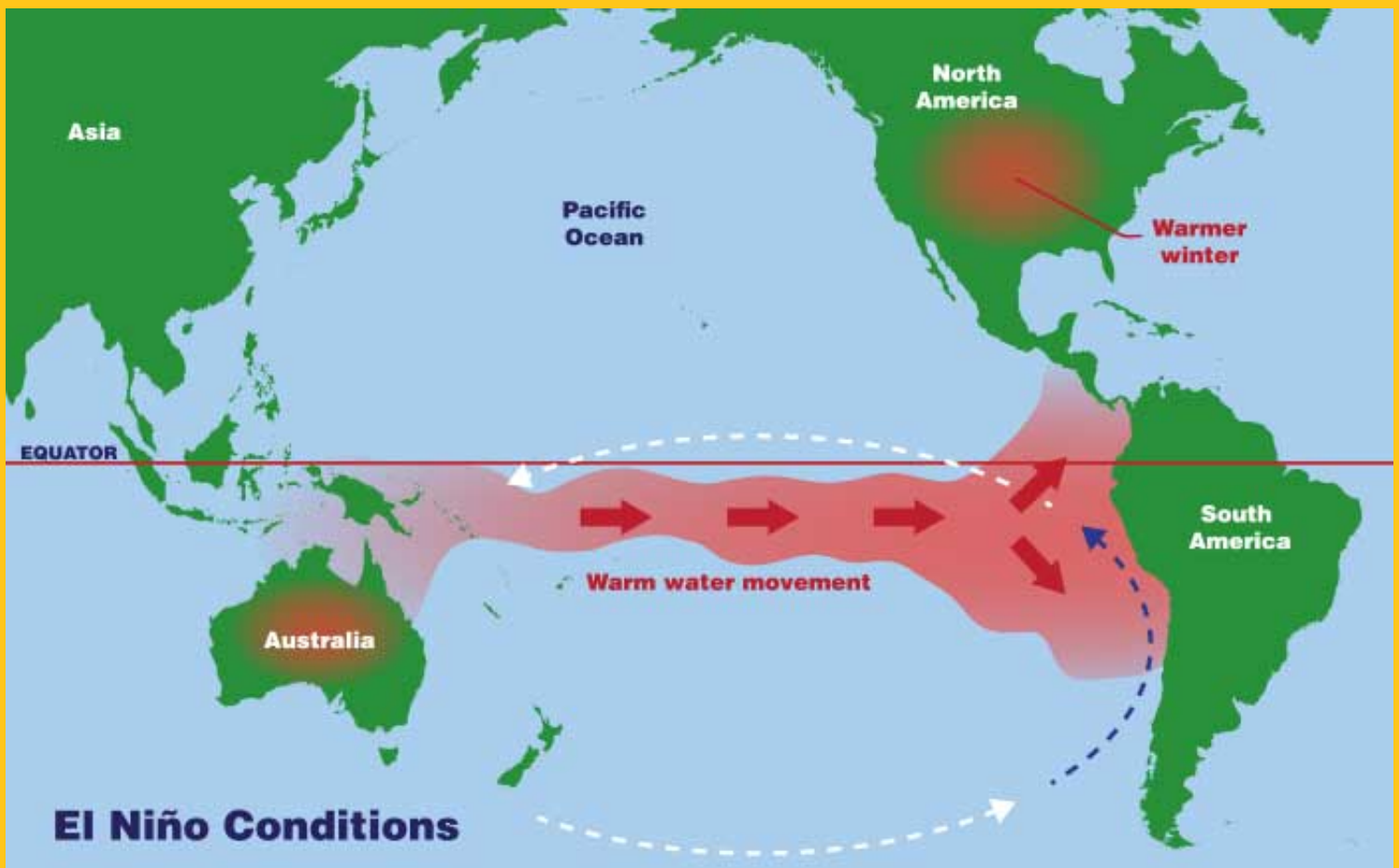
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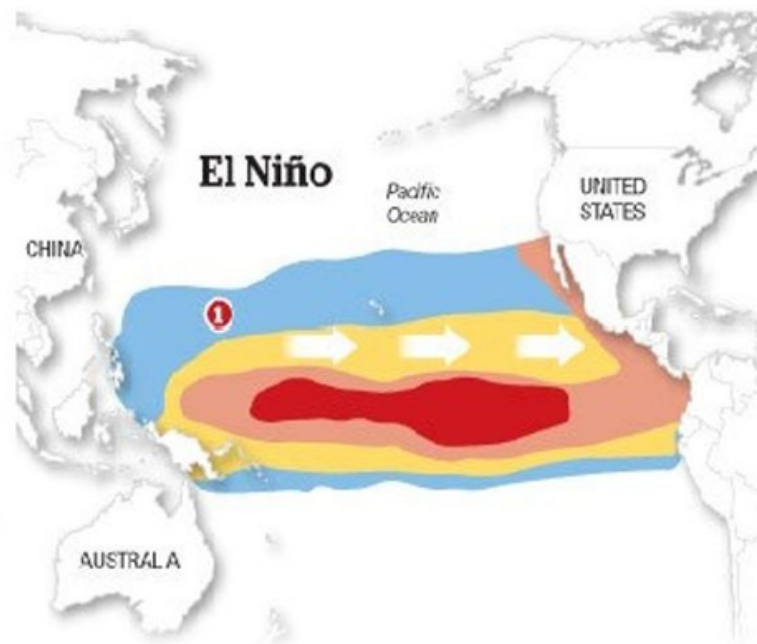
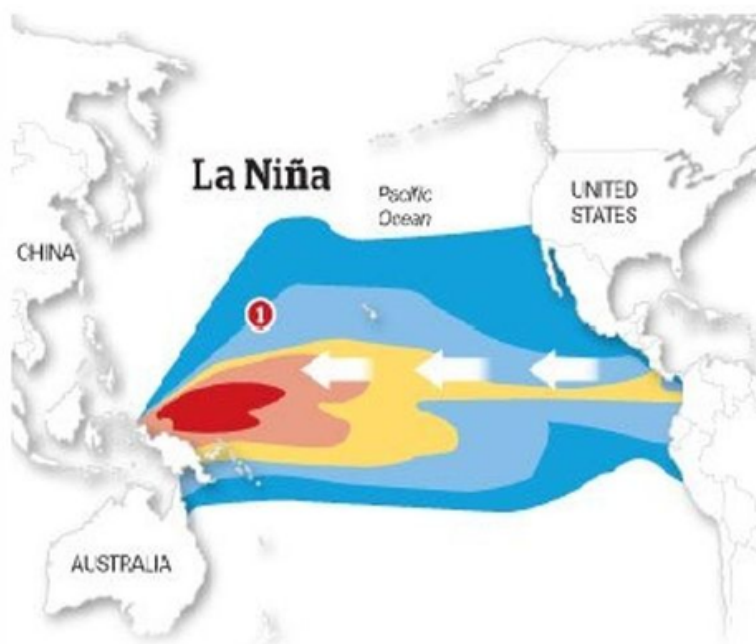
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- **Some scientists say climate change is making El Niños stronger and their impacts more extreme.**
-



# WHAT IS EL NINO??

- The term El Niño (Spanish for 'the Christ Child') refers to a warming of the ocean surface, or above-average sea surface temperatures, in the central and eastern tropical Pacific Ocean.





# On campaigning in the name of religion

What does Section 123(3) of the Representation of the People Act, 1951 stipulate? What about the Model Code of Conduct laid down by the Election Commission of India? Have the Courts ever convicted leaders for corrupt electoral practices?

## EXPLAINER

Rangarajan. R

### The story so far:

Recently the Bharatiya Janata Party (BJP) lodged a complaint with the Election Commission of India (ECI) against Rahul Gandhi for hurting the sentiments of Hindus through his remark on 'shakti'. The Dravida Munnetra Kazhagam (DMK), in turn, filed a counter complaint against the Prime Minister for appealing to religious sentiments during his campaign on the same issue.

### What does the law say?

Section 123(3) of the Representation of the People Act, 1951 (RP Act) provides that appeals by a candidate, or any other person with the consent of a candidate, to vote or refrain from voting on the ground of his religion, race, caste, community or language is a corrupt electoral practice. Section 123(3A) denounces any attempt by a candidate to promote feelings of enmity or hatred among citizens on these grounds during elections. The RP Act further provides that anyone found guilty of corrupt electoral practice can be debarred from contesting elections for a maximum period of up to six years.

### What does the MCC provide?

The Model Code of Conduct (MCC) for the guidance of political parties and candidates is a set of norms which has evolved with the consensus of political parties. They have consented to abide by the principles embodied in the said code. It binds them to respect and observe it in its letter and spirit. This code, which began to be implemented strictly in the 1990s, provides that no party or candidate shall indulge in any activity which may aggravate existing differences or create mutual hatred or cause tension between different castes, religious or linguistic communities. It also provides that there shall be no appeal to caste or



Secular values: A view of the Election Commission of India in New Delhi. SUSHIL KUMAR VERMA

communal feelings for securing votes. Mosques, churches, temples or other places of worship shall not be used as a forum for election propaganda. Though the MCC does not have any statutory backing, it has come to acquire strength in the past three decades because of its strict enforcement by the ECI.

### What has been the history?

It is pertinent to note that before 1961, Section 123(3) of the RP Act provided that 'systemic' appeal by a candidate on the grounds of religion, race, caste or community will amount to a corrupt electoral practice. However, in order to curb communal, fissiparous and separatist tendencies, the word 'systemic' was omitted through an amendment in

1961. This meant that even a stray appeal for success in the elections on the ground of one's religion or narrow communal affiliation would be viewed with disfavour by the law.

There have been innumerable instances in the past where various parties and its leaders have blatantly appealed for votes in the name of religion. There are leaders across political parties against whom cases have been registered under the RP Act and the Indian Penal Code in this regard. However, the only notable leader who was convicted by the Supreme Court for this corrupt electoral practice was Bal Thackeray of Shiv Sena in the year 1995. The ECI on such occasions at best bars leaders from campaigning, for violation of the MCC, for

a short period of two to three days.

### What has the Supreme Court ruled?

In *Abhiram Singh versus C. D. Commachen* (2017) a seven-judge Bench by a majority of 4:3 held that candidates shall not appeal for votes on the basis of not just his/her religion but also that of the voters. The majority view provided a 'purposive interpretation' to Section 123(3) rather than just a literal one thereby rendering any appeal in the name of religion of even the voters as a corrupt electoral practice. The elections to Parliament or State legislatures are a secular exercise; constitutional ethos forbids the mixing of religious considerations with the secular functions of the State. Religion should remain a matter of personal faith.

### What is needed?

Political parties and candidates are likely to raise legitimate concerns of citizens faced by them on the basis of traits having origin in religion, caste, community or language in a democratic election process. However, it should be to only address their grievances through appropriate policies without jeopardising the secular fabric and fraternity of the country. Any appeal in the name of religion only results in the further polarisation of our multi-religious society.

Places of worship have always been used overtly and covertly as a forum for canvass. Religious leaders have thrown their weight behind candidates of various parties. These practices should ideally be avoided in order to ensure that politics and religion are not mixed up. However, the primary responsibility lies with political party leaders and candidates. Their campaigns on the basis of religion not only disturbs the secular fabric of our polity but is also a clear violation of law. The ECI and courts should devise mechanisms for swift action against those violating the law in this regard.

Rangarajan R is a former IAS officer and author of 'Polity Simplified'. He currently trains civil-service aspirants at 'Officers IAS Academy'. Views expressed are personal.

## THE GIST

The Bharatiya Janata Party (BJP) lodged a complaint with the Election Commission of India (ECI) against Rahul Gandhi for hurting the sentiments of Hindus through his remark on 'shakti'.

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- Section 123(3A) denounces any attempt by a candidate to promote feelings of enmity or hatred among citizens on these grounds during elections.
- The RP Act further provides that anyone found guilty of corrupt electoral practice can be debarred from contesting elections for a maximum period of up to six years.



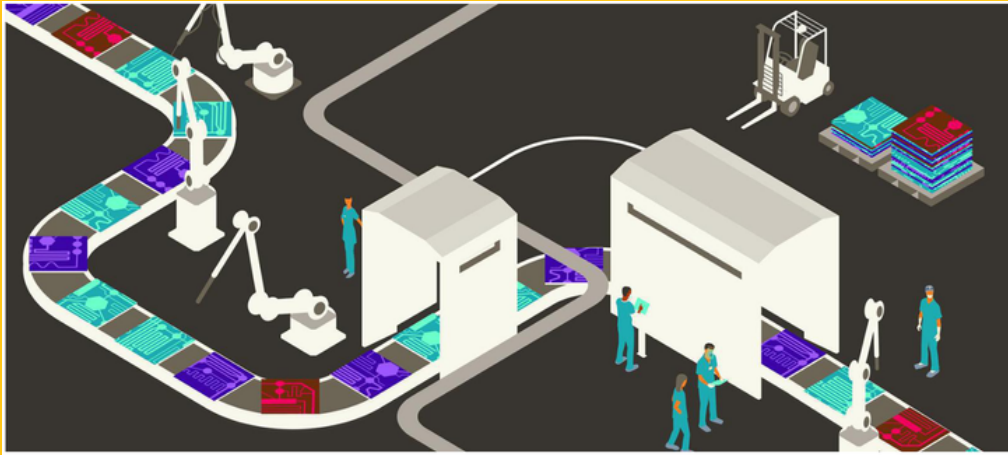
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- This code, which began to be implemented strictly in the 1990s, provides that no party or candidate shall indulge in any activity which may aggravate existing differences or create mutual hatred or cause tension between different castes, religious or linguistic communities.
- It also provides that there shall be no appeal to caste or communal feelings for securing vote



## What has the Supreme Court ruled?

- In **Abhiram Singh versus C. D. Commachen (2017)** a seven-judge Bench by a majority of 4:3 held that candidates shall not appeal for votes on the basis of not just his/her religion but also that of the voters.
- The majority view provided a ‘purposive interpretation’ to Section 123(3) rather than just a literal one thereby rendering any appeal in the name of religion of even the voters as a corrupt electoral practice.
- The elections to Parliament or State legislatures are a secular exercise; constitutional ethos forbids the mixing of religious considerations with the secular functions of the State. Religion should remain a matter of personal faith



# On semiconductors: how they are made, used and who manufactures them

Semiconductors influence nearly every facet of our lives. Many of the solutions to the 21st century's most important crises — including artificial intelligence, electric vehicles, space exploration, and environmental monitoring — bank on a steady supply of advanced semiconductors

Awanish Pandey

**W**hile the physical realm of human activity contains an array of languages, the digital realm is founded on just one fundamental binary language: the 1s and 0s, also called the bits of data. Computers represent these bits as electrical signals and this forms the foundation of modern computing, communication, social media, robotics, and artificial intelligence. The 0s and 1s constantly shape the way we interact with technology and with each other — and the beating heart of this binary revolution is the semiconductor device.

## What are semiconductors?

Semiconductors represent a distinct class of materials that possess some of the electrical properties of both conductors and insulators. Like a faucet which can be used to control the flow of water, semiconductors can be used to control the flow of electric currents, and with exquisite precision.

The most important type of semiconductor is the transistor. At the dawn of the era of modern electronics, the first integrated circuits featured four transistors. Together, they controlled the flow of currents in such a way that the circuits could perform simple arithmetic operations. Today, we have single chips boasting billions of transistors.

Fitting so many transistors on a tiny chip no bigger than a fingernail requires extreme precision and a microscopic eye for detail. For instance, the accuracy required is equivalent to dividing a strand of human hair into a thousand segments each of specific width, and further subdividing each segment into a hundred parts. This is why fabricating semiconductors involves cutting-edge technology and science.

## How are semiconductors made?

The process starts with an engineer

carefully selecting a silicon wafer as the foundation on which the semiconductor will be built. A team puts silicon, sourced from sand, through a meticulous purification process to separate it from other substances, until they have an ultra-pure wafer with impurity levels as low as a few parts per billion. (This percentage is comparable to an error of merely one cm when measuring the earth's diameter.)

Next is the photolithography process — a crucial step that carves the circuit pattern on the wafer. The wafer is coated with a light-sensitive material called a photoresist. Then, a mask is held in front of the wafer and light is shined on it. The mask contains small gaps in the shape of the circuit pattern. The light passes through these gaps and erodes the underlying parts of the photoresist. As a result, the photoresist on the wafer "acquires" the pattern of the transistor circuits.

Following photolithography, engineers use chemical and/or physical techniques to remove the uncarved parts of the photoresist, leaving behind the circuit's structure on the silicon substrate.

Then they dope the semiconductor, that is, deliberately add impurities to specific parts of the semiconductor to alter its electrical properties, and deposit thin layers of materials such as metals or insulators to the wafer's surface to form electrical connections or insulate components. Then the resulting product is packaged — individual chips are separated, encapsulated, and tested to make sure they're functional and reliable — and integrated into electronic devices.

## What does the fabrication landscape look like?

Each step in semiconductor fabrication demands ultra-high precision and harnesses a blend of diverse scientific principles. For example, to make the most advanced transistors, the photolithography process requires a light

source emitting electromagnetic radiation at a wavelength of 13.5 nm.

To achieve this, the High NA EUV machine made by the Dutch company ASML uses a cannon to shoot a 50-micrometre blob of liquid tin at 300 km/hr through a vacuum chamber, where laser beams blast it with enough energy to form a plasma that finally emits the requisite wavelength of radiation.

The semiconductor manufacturing process is characterised by specialisation, leading to an oligopoly controlled by companies specialising in specific domains. ASML, a spin-off of Philips, is in fact the sole provider of photolithography machines for cutting-edge semiconductor technology worldwide. The American firms Synopsys and Cadence dominate the software tools the engineers use to design circuits, while the silicon wafer sector is led by Japan's Shin Etsu.

The market for the actual task of fabrication is led by Taiwan's TSMC, with fabrication tools provided by Applied Materials and Lam Research, both headquartered in the U.S. The majority of intellectual property rights are held by British company Arm.

India boasts a leading role in chip design centred in Bengaluru. However, most of the intellectual property rights required to execute these designs are retained either by parent companies or by Arm, relegating India to being a mere user of their products. This setup is akin to the McDonald's business model: while India may host numerous McDonald's outlets, the recipe and supply chain are owned by a parent company headquartered in a different country.

## How do semiconductors benefit us?

Smartphones and computers showcase the pinnacle of semiconductor technology but semiconductors influence nearly every facet of our lives. Semiconductors also power 'smart' air-conditioners' ability to regulate the temperature as well as space telescopes'

ability to capture both awe-inspiring and scientifically interesting images in the depths of the universe, and many other technologies in between.

Many of the solutions to the 21st century's most important crises — including artificial intelligence, electric vehicles, space exploration, robotics, personalised healthcare, and environmental monitoring — bank on a steady supply of advanced semiconductors, underscoring their importance for the survival of the human race and its aspirations of equitability, sustainability, and justice.

Such semiconductor technology facilities foster innovation, create high-paying jobs, nurture the potential for deep-tech start-ups, and both draw from and feed into advances in materials science, computer engineering, big data, optics, chemical engineering, and chip design, to name a few.

Owing to their role in sectors like defence and automobiles, semiconductors have also emerged as a focal point of geopolitical interest, with nations vying to establish semiconductor fabrication facilities within their borders and drawing industry leaders in with a plethora of incentives. The U.S. also imposed sanctions on Chinese tech companies, including bans on the acquisition of cutting-edge ASML equipment and high-end design software, for the same reason. In response, China has intensified efforts to bolster its domestic semiconductor production capabilities to meet local demand.

India, meanwhile, has been trying to use its expertise in design to establish semiconductor manufacturing plants. One hopes this strategic push plus the potential of our youth will translate to numerous opportunities for the country to seize the international semiconductor industry.

Awanish Pandey is an assistant professor at IIT Delhi with the Optics and Photonics Centre.



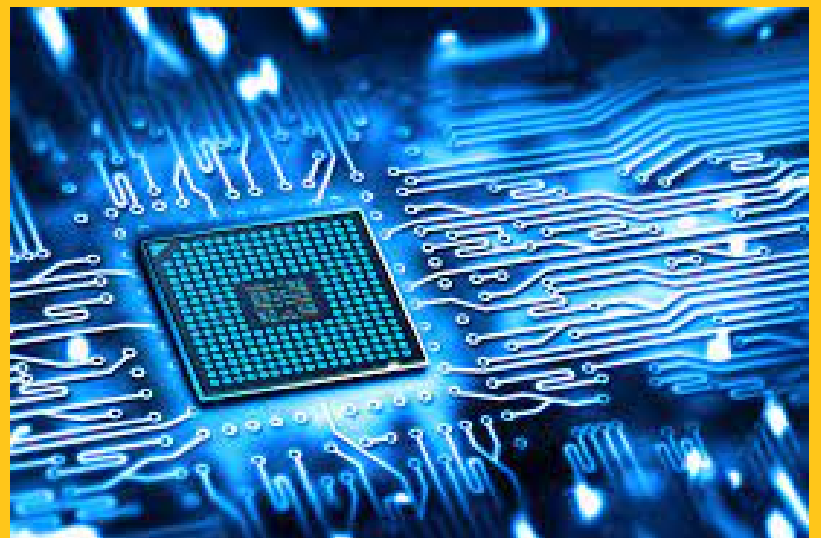
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# What are semiconductors?

## What are semiconductors?

- Semiconductors represent a distinct class of materials that possess some of the electrical properties of both conductors and insulators.
- Like a faucet which can be used to control the flow of water, semiconductors can be used to control the flow of electric currents, and with exquisite precision.
- The most important type of semiconductor is the transistor.







# How are semiconductors made?

- The process starts with an engineer carefully selecting a silicon wafer as the foundation on which the semiconductor will be built.
- A team puts silicon, sourced from sand, through a meticulous purification process to separate it from other substances, until they have an ultra-pure wafer with impurity levels as low as a few parts per billion.
-



- **Next is the photolithography process — a crucial step that carves the circuit pattern on the wafer. .**
- **The wafer is coated with a light-sensitive material called a photoresist.**
- **Then, a mask is held in front of the wafer and light is shined on it.**
- **The mask contains small gaps in the shape of the circuit pattern.**
- **The light passes through these gaps and erodes the underlying parts of the photoresist.**
- **As a result, the photoresist on the wafer ‘acquires’ the pattern of the transistor circuits.**



- **Following photolithography, engineers use chemical and/or physical techniques to remove the uncarved parts of the photoresist, leaving behind the circuit's structure on the silicon substrate.**
- **Then they dope the semiconductor, that is, deliberately add impurities to specific parts of the semiconductor to alter its electrical properties, and deposit thin layers of materials such as metals or insulators to the wafer's surface to form electrical connections or insulate components**



# Robusta coffee price touches all-time high amid global shortage

The price of robusta coffee has risen sharply due to a supply shortage and global factors, surpassing the price of premium arabica coffee

**E.M. Manoj**  
KALPETTA

**R**obusta coffee farmers in South India are jubilant post-harvest with their produce fetching an all-time high price.

The farmgate price of raw Robusta coffee berries touched a record ₹172 per kilogram (kg) in the Wayanad market on Saturday, as against ₹115 per kg during the same period last year. Meanwhile, the spot price of Robusta coffee beans stood at ₹315 per kg, up from ₹210 during the same period in 2023. The price was ₹80 and ₹145 per kg for raw berries and beans, respectively, in March 2022.

Though the harvest is almost complete, there has been a huge shortfall in the supply of coffee to the market this year, thereby contributing to the increase in coffee prices, said Salu George, a coffee trader in Wayanad.

## Multiple factors

"We expect a decline of 30% in Robusta production this year owing to climatic vagaries, especially the scanty blossom shower in Robusta-growing regions last year," Mr. George said.

A sharp decline in the production of Robusta coffee—nearly 2 million bags—in Vietnam, a major Robus-



**Prolonged scarcity:** Farmers say production may decline by 25-30% next year too owing to dearth of backup showers. FILE PHOTO

ta coffee-growing country, has also led to the rise in prices, sources added. Robusta coffee production in Indonesia too dipped sharply this year, they said.

Notably, the price of Arabica seeds has dropped below the price of Robusta. The farmgate price of the Arabica variety of coffee was ₹305 per kg on Saturday. While traditionally the Arabica variety fetched a premium price, it is now Robusta that is selling at a higher price due to its low availability.

Farmers expect production to decline by 25%-30% next year too owing to a dearth of backup showers in many Robusta coffee-growing regions.

Wayanad in Kerala, which is the largest Robusta coffee-producing district in the country after Coorg

in Karnataka, received a rainfall of 29.3 mm in the first week of January. Major parts of the district received no rain since then, Prasanth Rajesh, Director, Wayanad Coffee Growers' Association said.

The January showers helped in the blossoming of Robusta coffee plants, farmers say. But absence of backup showers, a major factor in the formation of berries, is a concern.

According to the Coffee Board of India, the total production of coffee in India during the 2022-23 fiscal was 3,52,000 tonnes, including 2,52,000 tonnes of Robusta coffee. The total value of India's coffee exports has risen to ₹5,279 crore during the ongoing coffee season, from ₹3,982 crore during the same period in the earlier season.



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# Why Robusta coffee price is high??

- Robusta coffee farmers in South India are jubilant post-harvest with their produce fetching an alltime high price.
- Though the harvest is almost complete, there has been a huge shortfall in the supply of coffee to the market this year.
- decline of 30% in Robusta production this year owing to climatic vagaries, especially the scanty blossom shower in Robusta-growing regions last year.
- Wayanad in Kerala, which is the largest Robusta coffee-producing district in the country after Coorg in Karnataka, received a rainfall of 29.3 mm in the first week of January.

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