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1. What would be the impact of the Baltimore bridge collapse?

Why in News?

The collapse of the Francis Scott Key Bridge on March 26 has put a spotlight on the Port of Baltimore, one of the busiest harbours in the U.S., which paused shipping and immediately halted all vessel traffic in and out.

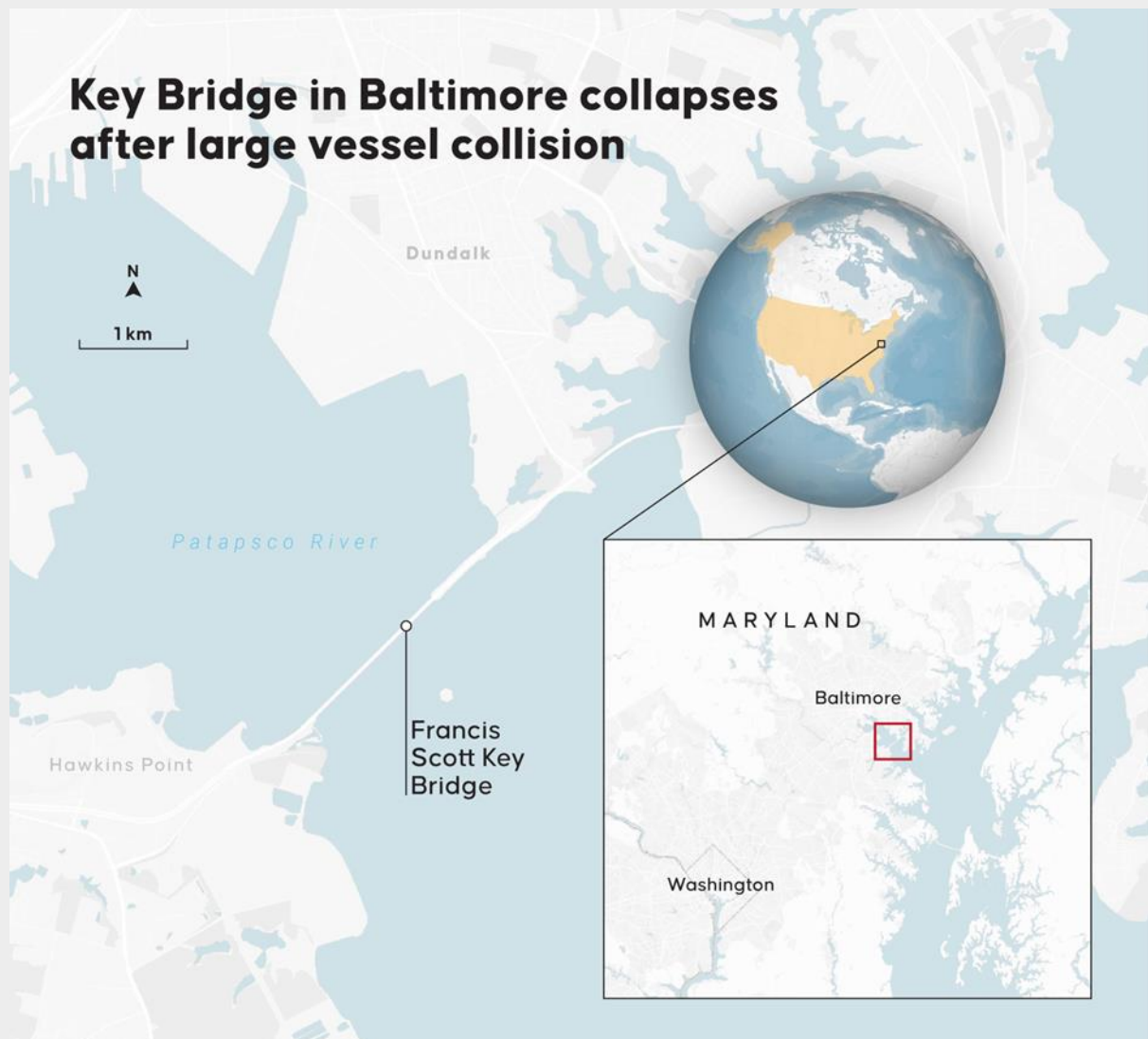


The port remained open to trucks following the incident, but the loss of maritime traffic is expected to cost \$9 million a day. The overall economic toll is likely to be higher as billions of dollars of goods are rerouted amid the prospect of supply chains being snarled for months. It will also mean a loss of tax revenue for the city and state.

Here, a supply chain and logistics expert from the University of Montana explains the short- and long-term impacts of the crash on supply chains.

How important is the Port of Baltimore?

The Port of Baltimore is the ninth largest U.S. port by overall trade volume. In 2023 alone, it moved around 50 million tonnes of goods between the U.S. and other countries, much of it in large shipping containers, like those stacked on the ship that rammed into the bridge. Although it's smaller than other ports on the East Coast and in the Gulf of Mexico, it still plays a critical role in processing U.S. international trade traffic.



What's the short-term impact of its closure on supply chains?

The immediate impact will be felt by the 15,000 or so workers in the port and about 1,40,000 others who depend on it. It doesn't mean they'll be laid off, but drastically less traffic would mean less work to go around. Companies and consumers should expect some delays for packages that would have otherwise been processed by the port.

What's the long-term impact?

The problem is that supply chains have been under stress from multiple directions lately. Houthi attacks on ships in the Red Sea and Panama Canal bottlenecks have lengthened delivery times and increased costs for companies that rely on East Coast ports. The pause in maritime traffic at the Port of Baltimore adds one more point of pressure for trade in the region.

How does this supply chain shock compare with other recent ones?

From a supply chain perspective, this was a freak accident. It's dramatic, it's graphic, and it forces people to pay attention to the issue. But unlike the Red Sea attacks or the impact from the COVID-19 pandemic, which have led to lingering supply chain problems, fallout from the bridge collapse will be temporary.

Relevance: GS Prelims

Source: The Hindu

2. What is the technology behind manufacturing a semiconductor chip?

Why in News?

Semiconductor chip manufacturing capabilities are currently limited to very few regions in the world. With supply chain disruptions during the pandemic and recent geopolitical tensions, many companies and countries, including India, have realised the importance of investing in chip manufacturing infrastructure.

The TATA group has partnered with Taiwan's Powerchip Semiconductor Manufacturing Corporation (PSMC) to set-up a 300mm wafer fabrication plant in Gujarat. It will roll out its first 28nm chip in 2026. Two assembly and test plants in Gujarat and Assam have also been recently approved by the Government of India.

What is a semiconductor chip? How is it manufactured?

A semiconductor has properties between a conductor (which conducts electricity) and an insulator (which does not). In its purest form a semiconductor is a very weak conductor of electricity. However, its electrical properties can be changed by adding small amounts of certain substances called 'dopants'. By taking a pure semiconductor and carefully injecting certain parts with specific dopants, complex circuits can be 'printed' on the semiconductor.

The process is crudely analogous to creating an intricate work of art on a paper or a wall, by using a bunch of stencils and spray paints of different colours. The stencils are called 'masks' in the industry and the paint is analogous to the dopant.

What is a transistor?

The transistor, one of the earliest electronic components to be built using a semiconductor, is an extremely versatile device. In its most popular form it can function as an electronic switch. A typical semiconductor chip can have millions/billions of these interconnected switches that work together to perform various logical and computational operations.

A transistor can also function as an amplifier (to amplify the weak signal received by your cell phone) and is an integral part of circuits that generate and process high frequency signals (such as those required in wireless communication technologies). Today all these different avatars of the transistor are routinely packed into a single semiconductor chip (such as the WiFi chip in your mobile).

The transistor demonstrated how a single device could be built out of a piece of a semiconductor. 'Printing' multiple devices onto a single piece of a semiconductor to create entire circuits was the next leap.

What is fabrication technology?

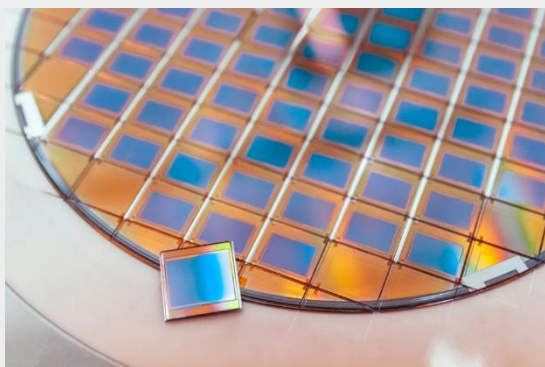
Technology has progressed at a relentless pace since the semiconductor chip was first conceptualised more than six decades ago. Newer manufacturing technologies have been introduced at a regular cadence. The level of miniaturisation of the semiconductor has increased by orders of magnitude. Sticking with the stencil analogy this is mainly due to the stencils being able to etch smaller and more intricate patterns. There have been equally impressive gains in the switching capability of the transistors. They are able to switch on-and-off faster (more computations per second) and with lesser power consumption (longer battery life and lesser heat dissipation).

The industry has used labels like '45nm', '28nm' and '16nm' to introduce each new manufacturing technology. 'nm' is short for nano-meter and refers to an extremely small unit of length equal to one billionth of a meter. These numbers convey the level of miniaturisation that is achievable using a particular technology (so smaller is better).

Though not always accurate, you can think of this number as representing the dimensions of single transistor. While traditionally electronic circuits have been laid out flat on the semiconductor, researchers are increasingly looking to capitalise on the third dimension (height). As the length and breadth of a transistor switch decreases, increasing its height can help ensure reliable performance. Stacking entire circuits on top of one another is another way to continue to shrink semiconductor chip sizes.

What is known as a wafer?

A semiconductor chip is manufactured much like a postage stamp. A sheet of stamps is printed on a piece of paper and then each individual stamp is cut out. Similarly, an array (typically 300-400) of chips are printed on a circular piece of semiconductor (called a wafer in industry parlance). This is then diced to create individual chips. A larger wafer size allows more chips to be printed on a single wafer which makes chip production faster and cheaper. Wafer sizes used in the industry have constantly been increasing. The current state of art is 300mm which is approximately 12 inches (this refers to the diameter of the wafer). Efforts are ongoing to move to a 450mm wafer size. While moving to a larger wafer size has its technical challenges and capital expenses, it has proven to be economical in the long run.



Once the wafer has been diced into chips, each individual chip has to be packaged in a protective covering. Tiny wires have to be routed from the device to the boundary of the package. Some of these wires supply power, while others are used for feeding in and reading out signals and data. A chip also has to be tested — this includes verifying its functionality and stress testing (subjecting the chip to high temperature and

voltages) — to ensure reliability during its lifetime. All this is performed in an assembly and test plant.

Relevance: GS Prelims & Mains Paper III; Science & Technology

Source: The Hindu

3. The citizen's 'climate rights'

Why in News?

The Supreme Court has ruled that people have a "right to be free from the adverse effects of climate change", which should be recognised by Articles 14 and 21 of the Constitution.

The judgment by a three-judge Bench headed by Chief Justice of India (CJI) D Y Chandrachud, was delivered on March 21 in a case relating to the conservation of the critically endangered Great Indian Bustard (GIB).



The Bench noted that the intersection of climate change and human rights has been put into sharp focus in recent years, underscoring the imperative for states to address climate impacts through the lens of rights.

What was the case before SC?

The apex court's ruling came in a writ petition filed by retired government official and conservationist M K Ranjitsinh, seeking protection for the GIB and the Lesser Florican, which are on the verge of extinction.

The plea sought, among other things, the framing

and implementation of an emergency response plan for the protection and recovery of the GIB — including directions for installation of bird diverters, an embargo on the sanction of new projects and renewal of leases of existing projects, and dismantling power lines, wind turbines, and solar panels in and around critical habitats.

Appeal for modification of 2021 order

In the hearing held in March, the apex court was considering an appeal for the modification of its April 19, 2021 order, which imposed restrictions on the setting up of overhead transmission lines in a territory of about 99,000 sq km in the GIB habitat in Rajasthan and Gujarat.

The Ministry of Power, the Ministry of Environment, Forest and Climate Change, and the Ministry of New and Renewable Energy had filed the application to modify the 2021 order on grounds that it had adverse implications for India's power sector, and that undergrounding power lines was not possible.

The three ministries also cited India's commitments on transition to non-fossil fuel energy sources vis-à-vis the Paris climate treaty as one of the key grounds for seeking a modification of the 2021 order.

What did the SC say?

The apex court modified its April 2021 order giving directions for underground high-voltage and low-voltage power lines, and directed experts to assess the feasibility of undergrounding power lines in specific areas after considering factors such as terrain, population density, and infrastructure requirements.

The ruling acknowledged that its earlier directions, "besides not being feasible to implement, would also not result in achieving its stated purpose, i.e., the conservation of the GIB". In essence, the ruling put the apex court's stamp of approval on the Union's affidavit on steps "for the conservation and protection" of the GIB.

However, the court also made several other observations on climate change, and on litigation in other jurisdictions.

How have the Courts interpreted Article 21 earlier?

The SC has historically acknowledged Article 21 as the heart of the fundamental rights in the Constitution. The SC has said that the right to life is not just mere existence, but that it includes all rights that make it a meaningful and dignified existence for an individual.

In the 1980s, the SC read the right to a clean environment as part of Article 21. A bundle of rights — including the right to education, the right to shelter (in the context of slum dwellers), the right to clean air, the right to livelihood (in the context of hawkers), and the right to medical care — have all been included under the umbrella of Article 21.

However, these "new" rights cannot be immediately materialised or exercised by a citizen. Despite the plethora of environmental rights cases, clean air is still a pressing concern. Such rights are actualised only when policies are framed and legislation enacted.

Then, what is the benefit of recognizing rights under Article 21?

Their express recognition as fundamental rights helps in two key aspects. First, as a nudge to Parliament to take note of these issues and second, by making constitutional courts an avenue for citizens to litigate these issues in future.

While dwelling on India's international commitments to mitigate the impact of greenhouse gas emissions, the apex court also noted that despite many regulations and policies to address the adverse effects of climate change, there was no single legislation relating to climate change and attendant concerns.

However, the absence of such legislation, the Bench said, did not mean that Indians do not have a "right against adverse effects of climate change".

Relevance: GS Prelims & Mains Paper II; Governance

Source: Indian Express

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