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The Hindu News Analysis
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NASA's DART Spacecraft
GS Paper III- Page 10

The NASA spacecraft-asteroid collision

What is the 'kick' method which was used to deflect an asteroid headed towards earth? How can the technique be further utilised for space mining technologies?

EXPLAINER

T. V. Venkateswaran

The story so far:

On September 27, at 4:44 am IST, the DART (Double Asteroid Redirection Test) spacecraft collided with the space rock Dimorphos (just 160 metres wide). NASA has confirmed that the collision of the auto-rickshaw sized 600 kilogram weighing DART, on the football stadium-sized Dimorphos, about five billion kilogram in mass (orbiting around the 780 metres wide primary asteroid Didymos), has deflected the trajectory of the pair of space rocks. This kinetic impact technique, which appears as the climax of Hollywood sci-fi movies like *Deep Impact* and *Armageddon*,is also known as the 'kick' method. It could one day save humanity from a potential cataclysmic collision by safely deflecting a killer asteroid on its course towards earth. It could also fuel space mining technologies and unleash the space economy in decades to come.

What are asteroids?

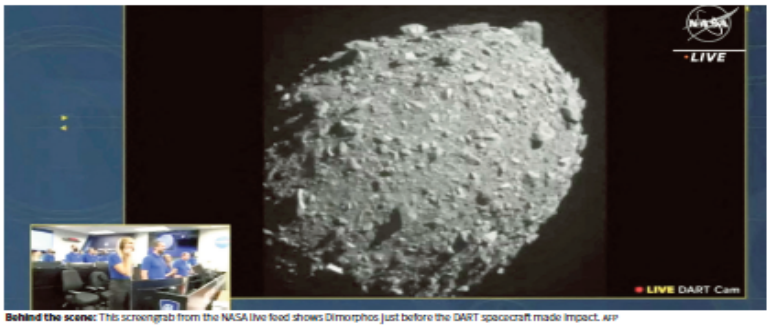
Around a construction site, bits and pieces of leftover bricks, unused steel rods, and emptied paint canisters are usually strewn. Likewise, leftover materials from the formation of the sun, earth and planets, through the accretion and agglomeration of giant gas and rocks, are scattered as comets, asteroids and meteoroids in the solar system. Some of these cross their path and collide with earth from time to time, resulting in a spectacular meteor shower. Most rocks are so small that they burn up completely in the atmosphere due to frictional heating. If they are large enough, the charred piece falls through as a meteorite. The falling piece from a meteoroid 140 metres wide or more will be capable of completely wiping out a city like Chennai. The impact would be devastating if it was one or more kilometres wide.

Neither the plot nor NASA's Planetary Defense Coordination Office, made famous by the blockbuster Netflix movie *Don't Look Up* is imaginary. About 66 million years ago, an asteroid about 10-15 kms struck earth. The tsunami, volcanic eruptions and thick dust clouds ensuing from the blow decimated dinosaurs and nearly 75% of all species. What happened in the past can occur in the future. The chances of a giant asteroid striking earth are small; however, if it did occur, the devastation would be cataclysmic, wiping out the entire human civilisation. While dinosaurs were mute spectators, humans can prepare themselves to face the imminent threat. NASA tracks and keeps a close watch on the nearly 26,115 asteroids whose orbits are dangerously close to earth.

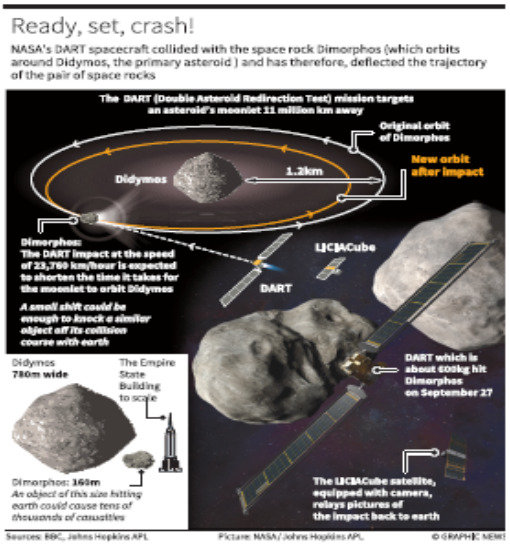
What was NASA's mission?

NASA, to put it simply, undertook the 'kick' technique. Compared to the massive Dimorphos, DART is a tiny Goliath. Yet crashing at a breakneck speed of 23,760 kilometres per hour, the momentum is adequate to slash the angular momentum of Dimorphos, making it speed up and move closer to Didymos. All of these reduce the orbital period and the time taken for the moonlet to go around the primary asteroid. The pair's trajectory is thus deflected as the net result of these dynamics. Consider it like this: a fast-moving moped slamming into a truck is sure to undergo a massive crash and burn, yet will veer the massive truck a bit. This is the essence of the 'kick' technique.

The extent of the trajectory change depends on the context. Compare throwing a ball against a solid wall and a sand pit. If the Dimorphos were solid, the crashing craft would make a dent on its surface and skim a tiny bit of its angular momentum, reducing the orbital time by about 75 seconds. However, close-up images transmitted by the DART moments before the fatal collision indicate that Dimorphos is more like a pile of rubble loosely held by gravity. If true, the impact will eject a cascade of debris, each piece carrying away a bit of momentum and energy. And as a net result, the asteroid will suffer a considerable loss. It will speed up more, and the orbit will become nearer to Didymos. The orbital period will then reduce by as much as 10 minutes.



Behind the scene: This screengrab from the NASA live feed shows Dimorphos just before the DART spacecraft made impact. AFP



What has been the impact assessment?

The DART craft carried a high-resolution DRACO (Didymos Reconnaissance and Asteroid Camera for Optical navigation) camera to observe the collision and its consequences. The close-up images until its fatal crash are being analysed. In addition, like a kangaroo with a baby in its pouch, a tiny toaster-sized Italian Space Agency-built Light Italian CubeSat for Imaging of Asteroids (LICIACube) took a piggyback ride with the DART.

The CubeSat was released and deployed two weeks before the impact. Hovering 50 kilometres from the asteroid, the two cameras aboard the CubeSat have captured the plume of the debris ejected by the collision. At 11 million kilometres, the asteroids appear like a blip of dot even through the best of telescopes. As they waltz around each other, once in 11 hours and 55 minutes, Dimorphos and Didymos line up, eclipsing one another. The total brightness of the pair darkens when Dimorphos passes in front of and behind Didymos.

Astronomers will now spend weeks and months observing the periodic change in the brightness using the telescopes to tease out the altered orbital period. All this data is still in process and will help fine-tune the technology.

What are the other possibilities of this technique?

At the heels of NASA, China is set to deflect a 40m diametre earth-crossing asteroid called 2020 PN1 sometime in 2026. While ostensibly the drive comes from the desire to protect earth from killer asteroids, perhaps the lure of space mining lurks behind. Mining rare earth elements comes with a high environmental cost. In the coming years, the penalty for polluting could make space mining economically viable. If one can tug a mineral-rich asteroid near the Moon or establish a space mining factory between the orbits of earth and Mars, precious mineral resources needed for decades could be easily sourced. The 'kick' technique that deflects asteroids can then be used to move a small asteroid into a convenient position for space mining. Now shelved, NASA's Asteroid Redirect Mission (ARM) aimed at precisely this by bringing a 20-tonne space rock near earth to study and mine. In a way, the DART mission is also part of this frame.

For developing green energy technologies – electric vehicles, solar panels, wind turbines, and energy storage devices – and ushering in the low carbon economy of the future, rare earth elements such as yttrium, niobium, rhodium, palladium, osmium, iridium and scandium are critical. They are short in supply, and asteroid mining, it is believed, could solve the rare earth supply problem.

From the robotic Soviet Luna 16 in the 1970s to U.S. Apollo missions and China's first lunar sample-return mission, Change 5 – all have brought back lunar soil. NASA's Stardust spacecraft returned a canister full of dust from comet Wild-2 captured by an aerogel-based sample collector in 2004. Japan Aerospace Exploration Agency (JAXA)'s Hayabusa 1 to 25143 Itokawa, the Hayabusa 2 to 162173 Ryugu, and NASA's OSIRIS-Rex to near-earth asteroid Bennu are missions to extract and return samples from asteroids.

T.V. Venkateswaran is Scientist F at Vigyan Prasar, Dept of Science and Technology

THE GIST

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While ostensibly the drive comes from the desire to protect earth from killer asteroids, the technique also carries the lure of space mining. If one can tug a mineral-rich asteroid near the Moon or establish a space mining factory between the orbits of earth and Mars, precious mineral resources needed for decades could be easily sourced. The 'kick' technique that deflects asteroids can then be used to move a small asteroid into a convenient position for space mining.

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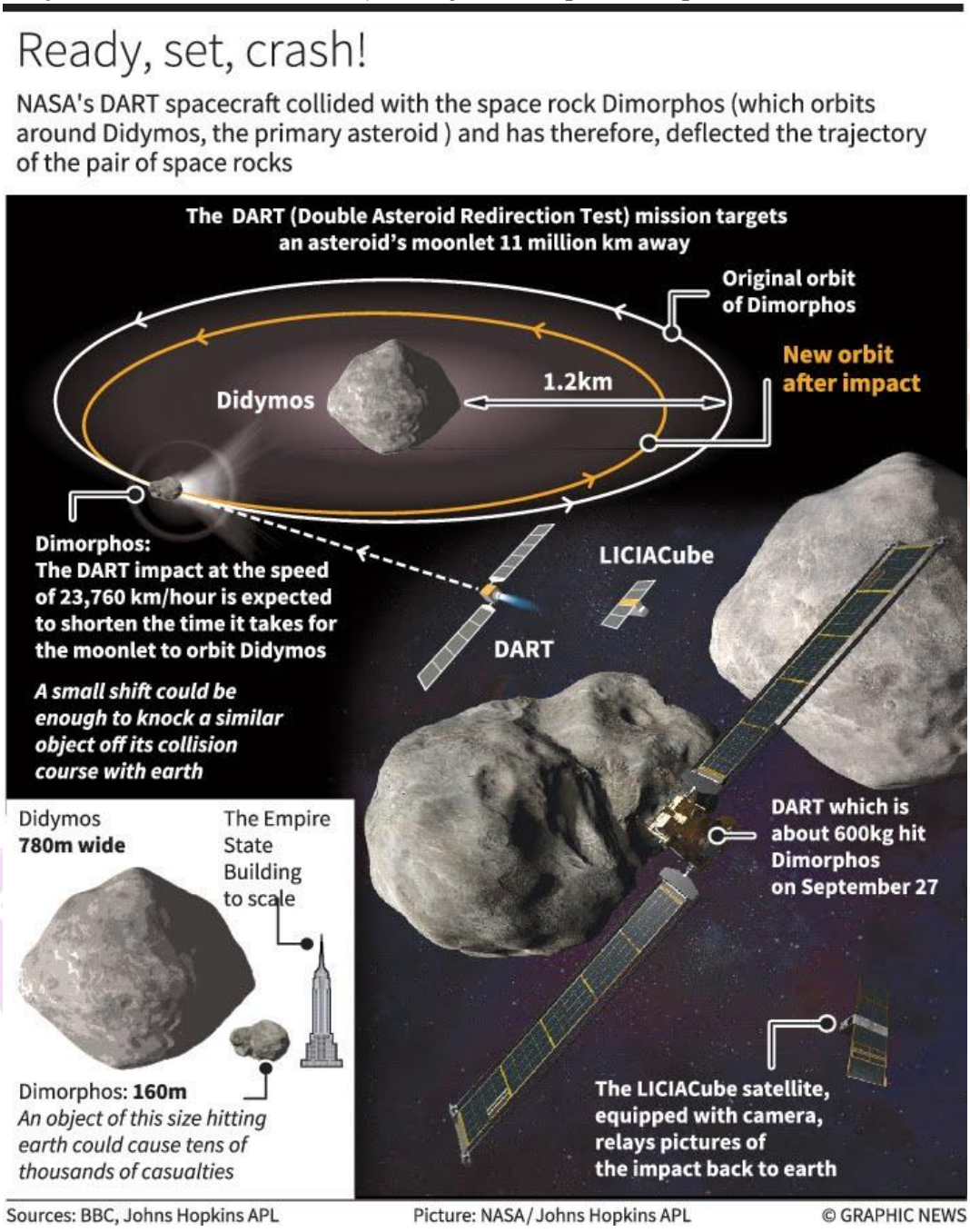

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- Aim: Desire to protect earth from killer asteroids.

The Hidden Agenda: Space Mining

- If one can tug a mineral-rich asteroid near the Moon or establish a space mining factory between the orbits of earth and Mars, precious mineral resources needed for decades could be easily sourced. Rare earth elements such as yttrium, niobium, rhodium, palladium, osmium, iridium and scandium
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Labour Bureau's AQEE Survey
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Jobs grew in final quarter of last fiscal, manufacturing is largest contributor: survey

Estimated employment in nine non-farm sectors rose from 3.14 crore during September-December 2021 to 3.18 crore in January-March 2022, says Labour Minister Bhupender Yadav; marginal increase in participation of women workers

The Hindu Bureau
NEW DELHI

Manufacturing continues to be the largest institutional employer in the country, employing about 38.5% of the workers, according to the fourth round (January-March 2022) of the Quarterly Employment Survey (QES), which is a part of the All India Quarterly Establishment based Employment Survey (AQEES).

The survey, which was released by Union Labour Minister Bhupender Yadav here on Tuesday, estimated that around 3.18 crore workers were employed in about 5.31 lakh establishments between January and March. It claimed an increase of about four lakh workers compared with the third round of QES, which was done for the last three months of 2021.

Education, manufacturing, trade and financial services together accounted for 84% of the total estimated units. "Manufacturing sector accounts for the largest percentage (38.5%) of the total number of workers, followed by education sector with 21.7%, IT/BPO sector with 12% and health sector 10.6%," the survey said. Almost 80% of the establishments engaged 10 to 99 workers. About 12% of the establishments reported fewer than 10 workers. Only 1.4% of the establishments surveyed reported at least 500 workers. "Such large establishments were mostly in the IT/ BPO sector and in the health sector," the report said.

The participation of women workers witnessed a marginal increase from 31.6% in the third quarter to 31.8% in the fourth quarter report. However, women workers constituted about 52% of the workforce in the health sector, while the corresponding percentages in education, financial services and IT/ BPO sectors stood at 44%, 41% and 36%, respectively.

"It is noteworthy that in financial services, women far outnumber males among self-employed persons," the report added.

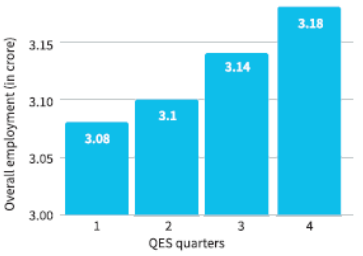
The survey said 86.4% of the workers were regular employees, and 8.7% were contractual employees followed by casual employees (2.3%) and self-employed (2%). "The share of fixed term employees in the establishments was found to be the least (0.7%) over all," the survey said.

Releasing the report, Mr. Yadav said employment was showing an increasing trend and estimated employment rose from 3.14 crore in the third quarter (September-December 2021) to 3.18 crore in the fourth quarter (January-March 2022). "It is important to mention here that the total employment in these nine selected sectors taken collectively was reported as 2.37 crore in the sixth economic census (2013-14)," he said.

The Labour Bureau had taken up AQEES to provide quarterly estimates about employment and related variables of establishments in both organised and unorganised segments of nine sectors – manufacturing, construction, trade, transport, education, health, accommodation and restaurant, IT / BPO and financial services.

Rise in jobs

An estimated total of 3.18 crore workers were found to be engaged in 5.31 lakh establishments during the 4th round (January-March, 2022) of the Quarterly Employment Survey, compared to a total of 3.14 crores in the third quarter



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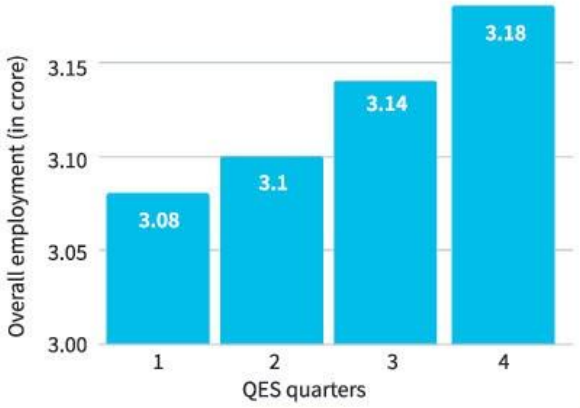

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Energising India-Nepal ties
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Energising India-Nepal ties, the hydropower way

On August 18, 2022, the Investment Board Nepal signed a Memorandum of Understanding (MoU) with India's National Hydroelectric Power Corporation (NHPC) Limited to develop the West Seti and Seti River (SR6) projects – a total of 1,200 MW.

Interestingly, nearly four years have passed since China's withdrawal from the project before Nepal decided to grant the project to India. Considering that hydro-power cooperation is a pillar in India-Nepal relations, there is a need to reflect on these questions: what does the decision offer to India and Nepal? What are the shared concerns and common interests? What are the options and alternatives?

Many hurdles

Historically, the 750MW West Seti Hydroelectric Project was thought of in the early 1980s as a 37 MW run-of-the-river scheme. Nepal issued the developing licence to France's Sogreah, which prepared a pre-feasibility study in 1987 proposing the scheme without building a dam.

With the project failing to see the light of the day, Australia's Snowy Mountains Engineering Corporation (SMEC) acquired a majority stake in the early 1990s. Between 1997-2011, attempts to make progress were affected due to investment and environmental concerns. Consequently, the China National Machinery and Equipment Import and Export Corporation stepped in in 2009, with SMEC holding a majority stake. However, China National Machinery and Equipment Import and Export Corporation withdrew citing a poor investment environment.

In 2011 Nepal revoked the licence of the West Seti Hydropower Company Limited in which SMEC had a majority stake, and handed it over to China. In an MoU in 2012, China's Three Gorges International Corporation was assigned to develop the project, but it withdrew in 2018, citing issues of resettlement and rehabilitation.

Subsequently, Nepal tried to develop the project by mobilising internal resources. However, increased costs resulted in further delays. Meanwhile, the project was remodelled as the West Seti and Seti River (SR6) joint storage project (1,200 MW).

Mukesh Kumar Srivastava

is Senior Consultant, Indian Council for Cultural Relations (ICCR), Ministry of External Affairs, Government of India

Nepal's move to involve India in completing the West Seti and Seti River (SR6) joint storage project has the potential to enhance much-needed cross-border power exchanges

Much potential

The decision to involve India is a sign that Nepal is reposing its faith in India to complete the project. If completed, it is expected to provide India the much-needed leverage in future hydropower cooperation.

The NHPC has initiated a preliminary engagement of the site with an investment of over ₹18,000 crore. It has also signed an MoU with the Power Trading Corporation Limited, India for sale of power. India is already involved in the Mahakali Treaty (6,480 MW), the Upper Karnali Project (900 MW) and the Arun Three projects (900 MW) in western and eastern Nepal, respectively. This will also help India minimise the geopolitical influence of China and firm its presence in Nepal, considering that the West Seti Hydroelectric Project was a major Chinese venture under the Belt and Road Initiative. In a tilt towards India, Nepal's Prime Minister Sher Bahadur Deuba said, "We failed to invest in this project... Since India is reluctant to purchase energy produced by Chinese companies in Nepal, we will talk with PM Modi for the engagement of Indian developers."

The project has the potential to enhance cross-border power exchanges between the two countries.

It is ironic that despite its huge hydropower potential, Nepal experiences power shortages during peak time, increasing its dependence on India to bridge the shortfall. With an estimated potential of 83,000 MW, Nepal's electricity exports to India are expected to increase foreign exchange and address the power shortage. It is estimated that if the hydropower potential is fully harnessed, Nepal can generate revenue to the tune of ₹310 billion in 2030 and ₹1,069 billion per year in 2045 by exporting electricity to India.

Similarly, India's severe deficit in coal-based thermal power plants in recent years, which meet 70% of India's electricity demand, has compelled the Government to arrange supplies through coal imports, accelerating the search for better alternatives. Given the growing energy demand, the West Seti Hydroelectric Project can provide an added alternative and viable way to address power deficits.

Steps to take

For the project to be successfully completed, options and alternatives need to be explored. First, the revised cost around the construction process has increased to $2.04 billion. Since investment-related constraints have delayed the project, there needs to be a careful study of investment scenarios, particularly a conducive investment environment, distribution and transmission network and cost of resettlement and rehabilitation, at the preliminary stage.

Second, Nepal is concerned that the electricity rates and supply from India is inadequate to meet the rising demands. To address these concerns, the new MoU has already revised the percentage share of energy that Nepal will receive free of cost from the generation projects to 21.9% from 10% (Section 6.1) and provides for discussion 'in good faith for further modalities, including Section 6.1' to make it commercially viable (Section 6.2). Further, to address domestic demand, the MoU allows Nepal to request the NHPC to sell the power generated from the projects to the domestic market before selling whole or part to the export market (Section 8.2).

Third, the project can also be extended to other regional partners under the Bangladesh-Bhutan-India-Nepal (BBIN) framework for cross-border energy cooperation. For example, if the combined estimated hydropower potential in Nepal and Bhutan, along with the potential of Northeast India, is effectively harnessed, a cross-border energy market can be created and optimally operationalised. It will be a win-win at the bilateral and regional levels.

The views expressed are personal

- Investment Board Nepal signed a Memorandum of Understanding (MoU) with India's National Hydroelectric Power Corporation (NHPC) Limited to develop the West Seti and Seti River (SR6) projects — a total of 1,200 MW.
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The Potentiality

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UNSC Permanent Seat
GS Paper II- Page- 8

Permanent membership of the UNSC is another story

Chinmaya R. Gharekhan

is former Permanent Representative of India to the United Nations

There is a buzz in India about the prospects of the country becoming a permanent member of the United Nations Security Council. India's External Affairs Minister has been actively canvassing for the country's candidature, meeting his counterparts from several countries. He has repeated the call, made often in the past, for a text-based negotiation on what has been euphemistically referred to as the reform of the United Nations Security Council (UNSC), i.e., negotiation on a written document outlining the proposed reform instead of just holding forth verbally.

The five permanent members of the UNSC – China, France, the Russian Federation, the United Kingdom and the United States – constitute what is the last, most exclusive club in international relations. All other clubs have been breached. Until a quarter century ago, the nuclear weapon club had five members, the same five as the P-5. India, Pakistan, North Korea and Israel have since joined the club. The P-5 could do nothing to stop the latter countries from forcing themselves into membership of the nuclear club. But the permanent membership of the Security Council is another story.

Declarations that deserve scepticism

The inescapable fact is that none of the P-5 wants the UNSC's ranks to be increased. One or the other of them might make some noise about supporting one or more of the aspirants. Each is confident that someone among them will torpedo the enlargement of the club. Declarations of support for India's candidature need to be taken with a fistful of salt.

When delegations of 50 countries were drafting the Charter of the future United Nations at Dumbarton Oaks near Washington DC in 1944-45, the article regarding the Security Council, particularly the right of veto, was the subject of maximum debate and controversy.

There should be no illusion about how states view membership in the United Nations Security Council — India must realise that it is all about national interest

REUTERS

Many countries opposed it. The British representative made it clear: either you have a United Nations with veto or there will be no United Nations. The other participating nations had to lump it. The chief Indian delegate said that it was better to have an imperfect United Nations than not to have one.

Intricacies of membership

There is considerable unhappiness among membership at large in the UN about the right of veto. The debate about veto is most often raked up when the western members of the P-5 club are not able to have their way. It is true that Russia, in its incarnations as the Soviet Union and the Russian Federation, has cast more vetoes (estimated to be 120 times, 'or or close to half of all vetoes') than the three western members of the club. But the western members have used their privileged position any number of times to protect Israel when the Palestinian question was being discussed. They also used veto to prevent sanctions being imposed on the apartheid regime of South Africa. There are no saints there.

India needs to be circumspect about veto. We ought to remember that the Russians have bailed India out on many occasions on the question of Kashmir. Most importantly, Russia helped India by vetoing unfavourable resolutions during the war of Bangladesh liberation in 1971. Looking ahead, we can never rule out the possibility of the Kashmir issue being raised in the Council at some time in the future. While we might expect, though not be certain of, Russia to come to our help, we must rule out either Britain or America from casting a negative vote against Pakistan. Going by the Chinese position of repeatedly blocking India's efforts to include confirmed Pakistani terrorists in the sanctions list, we can be sure of Chinese hostility towards us for a long time.

There are four declared candidates for permanent membership: India, Japan, Brazil and Germany, called the G-4. Africa and Latin America and the Caribbean are unrepresented in the permanent category at present. Africa's claim for two permanent seats has wide understanding and support, but the Africans have yet to decide which two countries these are to be. As for India, we can discount Pakistan's opposition; China will not support India nor will it ever support Japan. Brazil has regional opponents and claimants. As for Germany, Italy is firmly opposed to its claim. Italy has an interesting argument. If Germany and Japan – both Axis powers during the Second World War, and hence 'enemy' states – were to join as permanent members, that would leave out only Italy, the third founding member of the Axis group. In any case there are already three western nations among the P-5. Even if India enjoyed near universal support, there is no way that India alone can be elected; it will have to be a package deal involving countries from other groups.

There is quite a debate going on about whether the aspiring countries should accept permanent membership without the right of veto. There is no ambiguity regarding the position of the P-5. Every one of them is firmly opposed to conferring the veto power to any prospective new permanent member. Not just the P-5. The vast majority of members do not want any more veto-wielding members in the Council. There is a proposal to the effect that a resolution can be defeated only by a negative vote of at least two permanent members. This also is a non-starter; the P-5 are firmly opposed to any dilution of their privileged position.

Changing the membership of the Council requires amending the Charter. This involves consent of two-thirds of the total membership of the U N, including the concurring votes of P-5. This means that each of the five has a veto. The Charter was amended once in the 1960s to enlarge the Council by additional non-permanent seats.

Even now, if the proposal was to add a few non-permanent seats only, it would be adopted with near unanimity or even by consensus. It is the permanent category that poses the problem. One can have a good idea of the difficulty of amending the Charter by the fact that the 'enemy clause' contained in Article 107 of the Charter remains in it even though some of the enemy states such as Germany, Japan, Italy, etc. are very active members, often serve on the Council, and are close military allies of some of the victors in the war.

A new category is an idea worth considering

A distinguished group of experts suggested a few years ago that a new category of semi-permanent members should be created. Countries would be elected for a period of eight to 10 years and would be eligible for re-election. India ought to give serious consideration to this idea.

Some experts are of the opinion that India should not accept permanent membership without the right of veto. "We cannot accept second class status", is what they say. First, nobody is offering India permanent membership. Second, membership with veto power should be firmly ruled out. If by some miracle we are offered or manage to obtain permanent membership without veto, we must grab it. Even a permanent membership without veto will be tremendously helpful in protecting our interests. For, there should be no illusion about how states view membership in the Council. It is all about national interest; nobody is there for any worthy cause such as human rights or even war and peace. India will be and should be no different.

- India's Candidature as a Permanent Member
- Its modalities and obstacles
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The Way Forward

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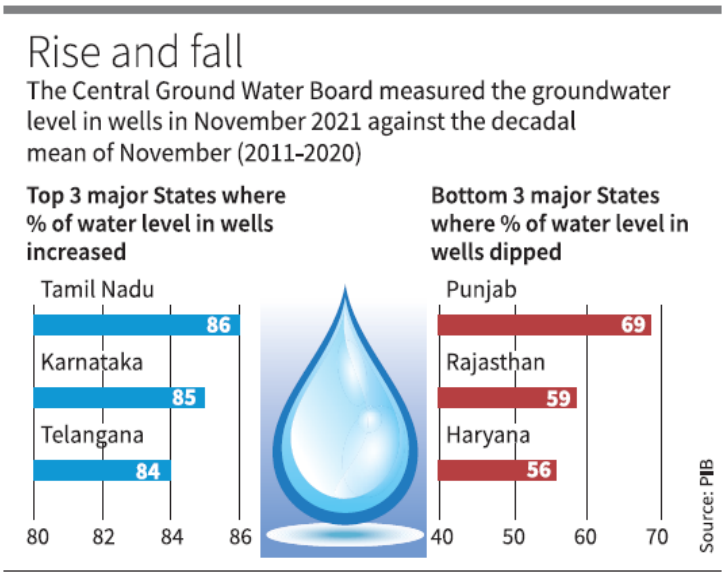
Jaldoot
GS Paper II- Page- 1 and 1

Govt. app to capture data on groundwater levels

The Hindu Bureau
NEW DELHI

With the rapidly declining water table threatening to push many regions into drought, the Union government on Tuesday launched a mobile application – Jaldoot – jointly developed by the Rural Development and Panchayati Raj Ministries to monitor the groundwater levels across the country.

The application was launched by Minister of State for Rural Development Faggan Singh Kulaste in the presence of Ministers Sadhvi Niranjan Jyoti and Kapil Moreshwar Patil.



The app will be used to capture the water levels of two or three open wells in every village twice a year, from May 1 to 31 during the pre-monsoon time and from October 1 to 31.

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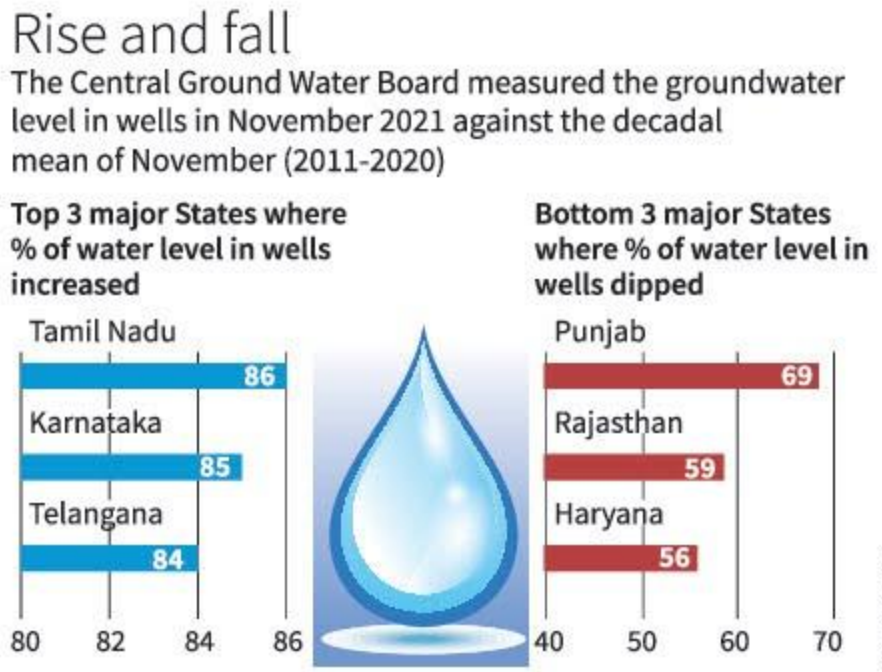
- With the rapidly declining water table threatening to push many regions into drought, the Union government on Tuesday launched a mobile application — Jaldoot
- Jointly developed by the Rural Development and Panchayati Raj Ministries to monitor the groundwater levels across the country



- The app will be used to capture the water levels of two or three open wells in every village twice a year, from May 1 to 31 during the pre-monsoon time and from October 1 to 31.
- To ensure transparency, the officers assigned for the task have been told to upload the geotagged photographs through the app each time the measurement is done.
- The mobile app, will work in online and offline modes to ensure that lack of Internet connectivity does not come in the way of the exercise.

Mains Questions

Q1. "NASA's DART program has the potentiality to avert the extinction of the humankind on Earth" Elucidate

(150 words, 10 marks)

Q2. "The Labour Bureau's AQEE survey is indicative of post COVID-19 economic recovery" Discuss

(150 words, 10 marks)