

● POLITY

● ECONOMICS

● TECHNOLOGY

● ECOLOGY

INTERNATIONAL RELATIONS

JAISHANKAR MEETS PUTIN, SAYS HE IS CONFIDENT OF RETURN OF ANNUAL SUMMITS

CONTEXT: External Affairs Minister S. Jaishankar expressed “confidence” over return of the annual India-Russia leadership summit, and hailing India-Russia relations as “very steady” and “very strong”.



External Affairs Minister S. Jaishankar held meetings after discussions with Foreign Minister Sergey Lavrov and Tuesday’s Inter-governmental Commission talks with Deputy Trade Minister Denis Manturovhi. The meetings have yielded a number of agreements on trade, connectivity, nuclear energy, military technology, and arms supplies.

“India-Russia relations remain very steady, remain very strong, they are based on our strategic convergence, on our geopolitical interests, and because they are mutually beneficial.”

- Mr. Jaishankar

He emphasised the wide range of agreements the two sides have signed, including one that will further Russian collaboration on the Kudankulam nuclear power plant, and one renewing diplomatic consultation protocols for the period between 2024 and 2028. India and Russia had agreed to deepen cooperation on the International North-South Transport Corridor that connects the two countries via Iran’s Bandar Abbas port, as well as the development of the Chennai-Vladivostok shipping route and the Polar Northern Sea routes.

External Affairs Minister S. Jaishankar and his counterpart Lavrov discussed a bilateral investment treaty, and plans to resume talks for the Eurasian Economic Union-India Free Trade Agreement in the “second half of January”. India-Russia bilateral trade has crossed \$ 50 billion in the past year, on the back of increased Indian imports of Russian oil and fertilizer in the wake of the war in Ukraine.

Diversification on mind, import of non-crude items also rose sharply from Russia

Russia's share (%) in total imports of key commodities



FY23 data is till January 2023.

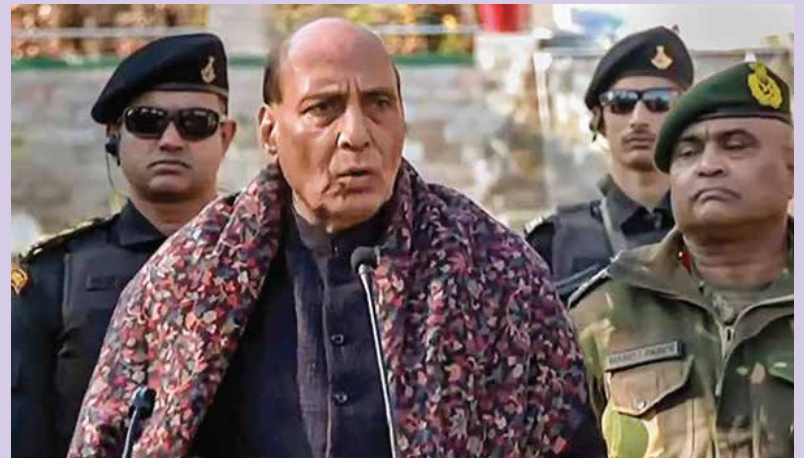
Chart: Nandita Venkatesan • Source: CMIE, Mint calculations

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INTERNAL SECURITY

RAJNATH MEETS KIN OF DEAD CIVILIANS, PROMISES JUSTICE

CONTEXT: Defence Minister Rajnath Singh met the families of the victims at Topa Peer village of Buziaz and assured them of an “expeditious investigation into the incident alleged torture by the Army and subsequent death of three civilians, culminating in deliverance of justice”.



Terming the deaths “unfortunate”, Mr. Singh directed all ranks to undertake operations based on hard intelligence, in accordance with established procedures aided by niche technology. National Conference president Farooq Abdullah urged the Minister to ensure that such incidents did not recur. Mr. Singh complimented the local people for their steadfastness and contribution to joining the Union government’s efforts at bringing the Union Territory into the mainstream.

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ECONOMICS AND DEVELOPMENT

CENTRE HIKES COPRA MSP BY ₹250-₹300 PER QUINTAL FOR 2024

CONTEXT: The Centre had decided to provide an MSP of at least 50 % higher than the production cost, though copra prices had fallen globally.

The Cabinet Committee on Economic Affairs (CCEA) decided to increase the Minimum Support Price (MSP) for milling copra for 2024 to ₹ 11,160 a quintal — an increase of ₹ 300 from the 2023 season. The new MSP for ball copra will be ₹12,000 per quintal — an increase of ₹ 250 per quintal. The rate will be effective from next year. Accordingly, the copra MSP has been increased by ₹ 250 - ₹ 300 per quintal for 2024 season. According to a government release, the new rates would ensure a margin of 51.84 % for milling copra, and 63.26 % for ball copra.

Kerala and Tamil Nadu are major producers of milling copra, whereas ball copra is produced predominantly in Karnataka. In 2023, the government has procured over 1.33 lakh metric tonnes of copra at a cost of ₹1,493 crore. Milling copra is used to extract oil, while ball/edible copra is consumed as a dry fruit and used for religious purposes.

INTERNAL SECURITY

HURRIYAT CHIEF'S OUTFIT AN UNLAWFUL ASSOCIATION: CENTRE

CONTEXT: The Union Home Ministry on Wednesday declared the Muslim League Jammu Kashmir (Masarat Alam faction) an “unlawful association” under the anti-terror Unlawful Activities (Prevention) Act (UAPA) for five years.



Masarat Alam has been in detention in Jammu and Kashmir for the past 20 years, with brief periods of release. Since 2019, he has been lodged in Delhi's Tihar jail. He was appointed chief of the separatist group — Hurriyat Conference — after the death of chairman Syed Ali Shah Geelani in 2021.

The notification said the MLJK-MA was known for its anti-India and pro-Pakistan propaganda and its objectives were to get freedom of Jammu and Kashmir from India so as to realise the merger of Jammu and Kashmir with Pakistan and establish Islamic rule.

Unlawful activities

The Ministry said the outfit had been involved in raising funds through various sources, including Pakistan and its proxy organisations, for perpetrating unlawful activities, including supporting terrorist activities, and the sustained stone-throwing on security forces showed sheer disrespect towards the constitutional authority and constitutional set-up of the country. The Ministry said there had been a number of inputs showing linkages of the Muslim League Jammu Kashmir (Masarat Alam faction) with banned terrorist organisations and its members had been involved in supporting terrorist activities with an intent to create a reign of terror in the country.

The Union government was of the opinion that unlawful activities of the MLJK-MA would be detrimental to the territorial integrity, security and sovereignty of the country; continue advocating the secession of Jammu and Kashmir from the Union of India; and continue propagating anti-national sentiments among the people of Jammu and Kashmir with the intention to cause disaffection against India and disrupt public order.

AGRICULTURE

GROW LOCAL, EAT LOCAL: BENGAL FARMERS HOLD A CELEBRATION OF INDIGENOUS SEEDS

CONTEXT: Farmers from several districts of West Bengal organised an indigenous seed festival, a one-of-its-kind, was held at Contai in Purba Medinipur earlier this month and took a pledge to conserve different varieties of native seeds.



The festival was organised by ActionAid, an NGO, along with Kajla Janakalyan Samiti and Purba Medinipur Kisan Swaraj Samity. ActionAid works in 22 States in India on the issue of climate resilience and sustainable farming.

Hundreds of farmers from various districts brought indigenous varieties of paddy, pulses and vegetables, and exchanged traditional knowledge among themselves. This is a unique initiative where practising farmers exchanged their knowledge of indigenous seed varieties.

Interface between farmers will help in building discourse between climate change and organic farming, and will help us understand and systematically expand the access and control over indigenous seeds. The NGOs plan to build a seed bank in different parts of the State at the grassroots level.

Pradut Samanta, an organic farmer from Paschim Medinipur district, is working to revive traditional paddy. This seed festival is a very pragmatic initiative because farmers are at a crossroads and have lost control over their input and made themselves vulnerable. They have also done lots of damage to their own soil, water as well as flora and fauna.

ECONOMICS AND DEVELOPMENT

INDIAN BANKS' ASSET QUALITY IMPROVED TO DECADAL HIGH: RBI

CONTEXT: The Gross Non-Performing Assets (GNPA) ratio of Indian Scheduled Commercial Banks (SCBs) consistently improved in the second quarter of FY24, sliding to a fresh decadal low, as per the Reserve Bank of India's (RBI's) report titled 'Trend and Progress of Banking in India'.

On a strong footing

Higher lending rates, lower provisioning needs boosted banks' profitability and shored up capital positions during 2022-23, says RBI



- UCBs' capital buffers, profitability improved
- NBFCs also showed better profitability, asset quality in 2022-23
- Capital to Risk Asset Ratio higher than the norms for NBFCs

■ Combined balance sheet of UCBs expanded by 2.3% in 2022-23

The GNPA ratio of SCBs fell to a decadal low of 3.9% at end-March 2023 and further to 3.2% at end-September 2023. About 45% of the reduction in SCBs GNPA's during 2022-23 came from recoveries and upgradations. The consolidated balance sheet of SCBs (excluding Regional Rural Banks) grew by 12.2% in 2022-23, the highest in nine years. The main driver of this growth on the asset side was bank credit, which recorded its fastest pace of expansion in more than a decade.

During 2022-23, the combined balance sheet of commercial banks expanded in double digits, driven by sustained credit growth. Higher lending rates and lower provisioning requirements helped improve the profitability of banks and shored up the capital positions.

The capital to risk weighted assets ratio (CRAR) of SCBs was 16.8% at end-September 2023, with all bank groups meeting the regulatory minimum requirement and the common equity tier 1 (CET1) ratio requirement. The combined balance sheet of urban co-operative banks (UCBs) expanded by 2.3% in 2022-23, driven by loans and advances. Their capital buffers and profitability improved through 2022-23 and Q1:2023-24.

NBFCs expand

The consolidated balance sheet of non-banking financial companies (NBFCs) expanded by 14.8% in 2022-23, led by double-digit credit growth. "Profitability and asset quality of the sector also improved in 2022-23 and in H1:2023-24, even as the sector remained well-capitalised with Capital to Risk (Weighted) Asset Ratio (CRAR) higher than the regulatory requirement."

Looking ahead in 2024, the RBI said, in this environment, banks must guard against credit losses although higher capital buffers and provision coverage ratio (PCR) provide cushions. Qualitative metrics such as enhanced disclosures, strong code of conduct and clear governance structures would contribute towards financial stability. Stating the global environment remained highly uncertain, the central bank said the Indian banking system was well positioned to improve further.

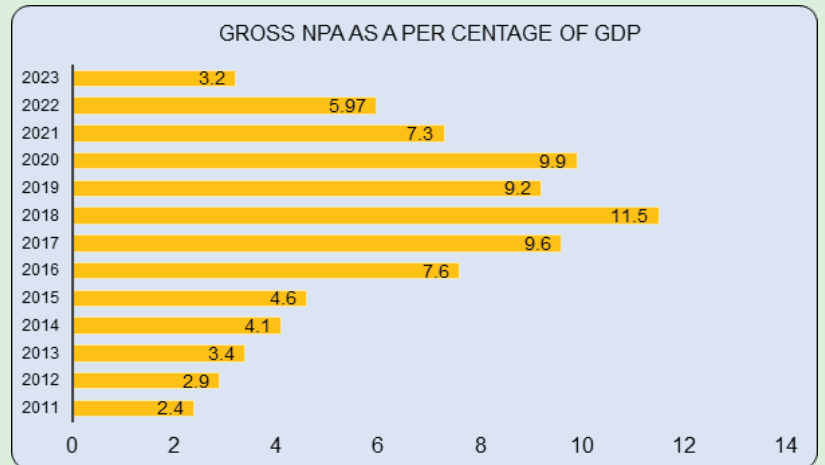


FIGURE: Bar chart representation of the Gross Non-Performing Assets (GNPA) ratio of Indian Scheduled Commercial Banks (SCBs)

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ECONOMICS AND DEVELOPMENT

ROBUST FPI DEBT INFLOWS SEEN AHEAD OF INCLUSION OF BONDS IN GLOBAL INDICES

CONTEXT: Foreign portfolio investment surge in the debt market can be expected in early 2024, ahead of the inclusion of Indian bonds in global indices in June.

JP Morgan announced 23 Indian bonds will be included in its Global EM bond index with a notional value of \$330 billion from June. The share will rise up to 10% in 10 months. In 2024, Indian sovereign bonds are not only expected to be included in JP Morgan's EM Bond Index but also in other global indices attracting additional inflows of \$40-50 billion. The inclusion of Indian bonds in JP Morgan bond indices will have investors take positions in Indian bonds three-six months in advance.

When Indian bonds, essentially government securities (G-Secs), are included in a global index, the Indian bond market is sure to get a fillip as foreign funds would buy G-Secs in larger quantities. The country can expect to see "front-loaded FPI inflows" in the debt segment in the first quarter of calendar 2024. This is also expected to give the country the cushion to comfortably finance the current account deficit, despite the risk of some widening in the second half of this fiscal.

On September 22, JPMorgan announced the inclusion of Indian government bonds to its Government Bond Index-Emerging Markets (GBI-EM) Global Index Suite from June 2024. It has set off anticipation that foreign investors will pump in billions of dollars into India to buy its sovereign debt. According to economists, India could potentially become a part of even bigger global bond indices in 2025.

Chief Economic Advisor V. Anantha Nageswaran noted that JP Morgan's move to include Indian government bonds in its global emerging market bond indices could potentially lower the country's sovereign borrowing costs, help finance the current account deficit and free up liquidity for domestic financiers to deploy in more productive assets. In a September 21 note, JP Morgan conveyed India's inclusion into its emerging market bond indices from June 28, 2024, starting with a 1 % exposure to 23 "index eligible" bonds with a "combined notional value of \$ 330 billion".

The bonds' inclusion staggered over 10 months till March 2025 with the Indian securities expected to reach their maximum weight of 10 %.

- Foreign ownership in the Indian government bonds market, reckoned to be the third-largest among emerging markets at \$1.2 trillion, is less than 2 %, one of the lowest among its peers.
- Higher foreign ownership would "relieve" the Indian financial system from having to be these bonds' biggest buyers and thus be in a position to lend that money for more productive purposes.

- Trigger some appreciation of the rupee, which could prove a challenge as keeping it competitive is also important, and expose bond and currency markets to external turbulence, but on balance, the benefits outweigh such concerns.

'India G-secs to attract \$30 bn on entry into JPM's indices'

The inclusion of Indian government bonds in JP Morgan's bond indices could draw foreign fund inflows in the range of \$30-\$40 billion over the next 18 months. The inclusion could prompt passive inflows of about \$30 billion and at least another \$10 billion from other funds.

Quantum mechanics: The of Indian Government Bonds to its Government Bond Index-Emerging Markets (GBI-EM) Global Index Suite will happen in 10 monthly increments of 1 percentage point each, starting June 28, 2024. Economists have pegged the quantum of inflows following this development at \$ 24 billion. India's presence will rise in not just in the GBI-EM Global Diversified index, but also other JPMorgan indices such as the JADE Global Diversified index and the JADE Broad Diversified index. Overweight/Underweight could potentially translate into higher/lower inflow.

Demand over supply: Greater foreign inflows next year will result in increased demand for Indian government bonds. At the same time, 2024-25 could also see the Centre borrow a smaller amount compared to ₹15.43 lakh Cr. this year as the fiscal deficit target could be around 5.5 % of GDP. This dual movement of increased demand for and possibly reduced supply of government bonds could result in the former exceeding the latter by as much as ₹ 90,000 Cr. Demand for G-sec (government securities) could now outstrip supply, unusual in domestic G-sec market, where supply has traditionally outstripped demand for G-sec. The natural consequence of the above is lower bond yields. According to Ghosh, the 10-year government bond – which closed at 7.15 % yield on September 25 – could fall to 7 % yield by the end of 2023-24 and affirmatively breach 7 percent next financial year. UBS, meanwhile, has lowered its 2024 forecast for 10-year yield to 6.75 % from 7 %.

From rupee to CAD: Capital inflows should mean a stronger rupee. The US dollar's strength and rising crude oil prices will prove to be headwinds, at least in the short term. In a strong US dollar environment, the Reserve Bank of India (RBI) will continue to play a crucial role, and may also likely accumulate dollars passively to absorb any heavy flows, given its focus on ensuring a more stable currency on top of internationalisation efforts. Even though the RBI is expected to step in and keep the rupee from appreciating wildly, the external balance will nonetheless improve. According to HSBC economists, the large inflows will likely keep the Balance of Payments "in strong surplus" even though the current account deficit may widen. Sen Gupta of IDFC First Bank sees the current account deficit in 2024-25 at 2 % of GDP, unchanged from 2022-23.

Increased scrutiny: A key challenge would be outflows – and the associated financial market volatility – due to non-India developments. As India's G-sec market attracts more global flows, it could also become more dependent on global financial conditions, which could add volatility. Strong institutions-backed, rules-based policy making will become even more critical in such times. One rule that will certainly become more critical is the Finance Ministry's annual fiscal deficit target. The Centre aims to cut it down to 4.5 % of GDP by 2025-26 and the idea – at least to begin with – was to reach 3 %. With more eyes on India's fundamentals, annual fiscal slippages may not be tolerated to the extent they have been until now.

residents in a region which has not been supportive of militancy in the near past.

One of the aims of militants in the asymmetric warfare waged against Indian security forces is to provoke the forces into committing rights violations against civilians and to use grievances and indignation among them to increase their own support base. Such actions by security forces play into the hands of militants and their handlers across the border. Second, the legitimacy of force or violence and its use by the state depend on the justness of the actions. Indiscrimination in the use of violence targeting civilians without just cause only results in the questioning of that legitimacy in the eyes of the people.

INTERNAL SECURITY

UNJUST AND UNWISE

CONTEXT: Security forces have to tackle not only terrorism but also engage in counter-insurgency operations in a precise and just manner in a conflict-prone border province such as Jammu and Kashmir (J&K).

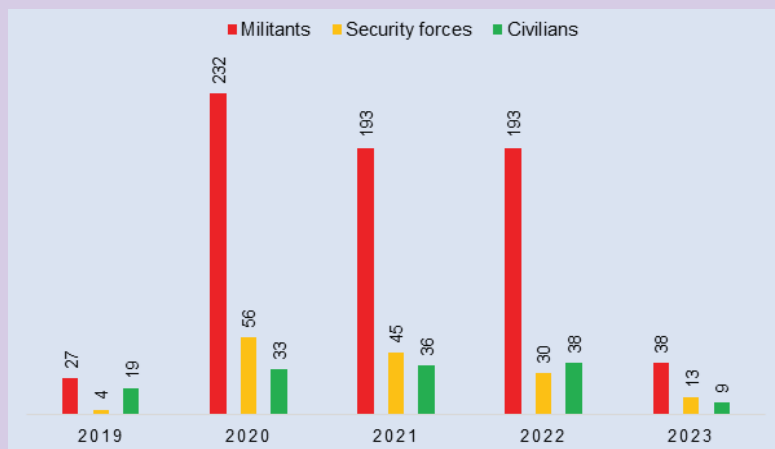


FIGURE: Column chart representation of the casualties in the Jammu and Kashmir.

The Pir Panjal Valley, comprising Poonch and Rajouri districts, has witnessed fierce encounters between security forces and militants in jungle terrain, leading to the death of 28 soldiers this year. This is a blow against counter-insurgency in an area that has been relatively more peaceful in comparison to the Kashmir Valley. In fact, the Pir Panjal region has been experiencing militancy in the last two years after relative calm for a decade and a half.

The death of three civilians who were detained by the Army in the Poonch-Rajouri area following a deadly ambush on an Army convoy on December 21, and the fact that five other civilians were badly injured due to alleged torture by the security forces, is a severe indictment of the counter-insurgency tactics there. Such heinous actions by security forces targeting civilians in response to militant attacks are clearly problematic, on two counts.

First, this increases the unpopularity of a regime that has not been democratically elected in the Union Territory where provincial elections have not been held for more than half a decade. Counter-insurgency operations of the kind that followed the ambush last week breed discontent among

POLITY AND GOVERNANCE

GROWTH CHARTS — WHO STANDARDS VERSUS INDIA CRAFTED

CONTEXT: High levels of child undernutrition have been a persistent problem in India. The determinants of undernutrition are multiple, and include food intake, dietary diversity, health, sanitation, women's status and the over-arching context of poverty.

The most common measures of childhood undernutrition are based on anthropometric standards such as height-for-age (stunting/chronic undernutrition) and weight-for-height (wasting/acute undernutrition). Monitoring these is key to tracking progress in terms of actual outcomes. India, like most other countries, uses the globally accepted World Health Organization (WHO) Growth Standards to measure malnutrition. However, there is an emergent debate on a number of issues related to the use of these growth standards in India.

On using the MGRS as the base

The WHO standards are based on a Multicentre Growth Reference Study (MGRS) that was conducted in six countries between 1997 and 2003 (Brazil, Ghana, India, Norway, Oman and the United States). The sample for India in the MGRS was drawn from a set of privileged households living in South Delhi, of children who met all the eligibility criteria for the study including having a 'favourable' growth environment, being breast-fed and having non-smoking mothers. The purpose was to determine the pattern of growth (from birth to five years) of children who did not face any known deficiencies in their environments. The references that were previously used (WHO-National Center for Health Statistics references) were based on children only from the U.S., many of whom were not breastfed but formula-fed. The MGRS took a prescriptive approach, with the specific aim of setting growth 'standards' (how children ought to grow, provided they have a healthy environment) and not growth 'references' (how children of the reference group grow).

Some researchers who have analysed data from other surveys for India suggest that these standards overestimate undernutrition. However, such comparisons with other large datasets would only be valid if these could provide samples that meet all the criteria of a favourable environment for growth, as defined by the MGRS. An adequate number of equivalent samples are difficult to find in large-scale surveys in India given the high levels of inequality as well as the underrepresentation of the rich in these datasets. For instance, even among children (six-23 months) in households of the highest quintile in National Family Health Survey (NFHS)-5 (2019-21), only 12.7 % meet the requirements of a 'minimum acceptable diet' as defined by WHO. While almost all mothers in the MGRS sample had completed more than 15 years of education (in 2000-01), 54.7 % of women in NFHS-5 had completed 12 or more years of schooling.

Such comparisons could also be misleading because the study norms of the WHO-MGRS were very different from these prevalence studies. For example, the MGRS included a component of counselling to ensure appropriate feeding practices, which is obviously missing in the NFHS or Comprehensive National Nutrition Survey. In fact, once it is understood that the MGRS sample was for the purpose of setting prescriptive standards, most of the sampling concerns are resolved. Some further issues raised vis-à-vis the MGRS methodology such as pooling of data from different countries have been discussed in detail in the study reports.

Genetic growth, other concerns

Another important set of issues with regard to using the MGRS standards is the difference in genetic growth potential of Indians with respect to others and the influence of maternal heights on child growth. At an individual level, maternal height is undeniably a non-modifiable factor for the growth of her child. Therefore, there is a question of how much improvement is possible in one generation, if at all. However, low average maternal heights are themselves a reflection of the intergenerational transmission of poverty and poor status of women, and, therefore, a measure of an environment of deprivation. An appropriate indicator of a deficient environment, such as stunting, needs to capture this deprivation as well.

A number of countries with similar or even poorer economic conditions, including those in the South Asian region, have shown higher improvements in stunting prevalence using the same WHO-MGRS standards. Regional differences within India, both in the prevalence of stunting as well as increases in adult heights, also indicate that some States such as Odisha, Chhattisgarh, Tamil Nadu and Kerala are achieving much faster reductions than others. It also needs to be considered that gene pools also shift at the population level with greater socio-economic development — a fact demonstrated by the growing average heights of countries such as Japan, refuting the immutability of genetic potential.

Another serious concern is related to inappropriately high standards leading to a misdiagnosis of the situation, and

a resultant potential overfeeding of misclassified children under programmes of the government introduced to address undernutrition, thereby resulting in an increase in overweight and obesity. This is a worry, given the increasing burden of non-communicable diseases (NCDs) in India. Nevertheless, given the dietary gaps that children have and the poor coverage of schemes such as mid-day meals and supplementary nutrition in anganwadis, such fears appear largely unwarranted. Indeed, the quality of the meals under these schemes must be improved to ensure that they are not cereal-heavy, include all nutrients, and contribute to dietary diversity. Recommendations such as including eggs in meals for children and pulses in the Public Distribution System must be acted upon urgently. It is also well understood that along with improving diets, multiple interventions such as better sanitation, access to health care, childcare services and so on are required for better nutritional outcomes.

There is also no doubt that there are also many gaps to fill in the more distal determinants of stunting, mainly; livelihoods and poverty, access to education and women's empowerment. These goals are inextricably linked to the overall development of the country, with equitable distribution of resources. Their reflection in anthropometric indicators only enhances the importance of these summary indicators rather than detract from it. It is relevant to acknowledge that individual children grow uniquely, and trained child health personnel such as treating physicians can apply judgement calls on the interpretation of growth charts in the context of individual children in their care. What these standards are used for are mainly to understand population trends. Using the appropriate standards is also important for international comparisons and intra-country trends — an advantage that would be lost with any new country-specific standard.

ICMR recommendation

The Indian Council of Medical Research that constituted a committee to revise the growth references for India recommended a detailed rigorous study to be conducted across the country to examine child growth with the purpose of devising national growth charts, if necessary.

Yet, while acquiring newer, and more precise information on child growth is a welcome move — considering our high aspirations of reaching development to every last person by 2047 and its advantages of comparability — it seems logical to stick to the aspirational high but achievable standards suggested by the WHO-MGRS.

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POLITY AND GOVERNANCE

MAKING HEALTH OUR TOP PRIORITY IN 2024

CONTEXT: According to a World Health Organization (WHO) report titled 'Invisible Numbers', a staggering 66 % of deaths in India in 2019 were attributed to NCDs. The report also suggests that 22 % of individuals aged 30 or older in India would succumb to NCDs before their 70th birthday, surpassing the global probability of 18 %.

A quiet crisis

The silent epidemic of NCDs is fuelled by common behavioural risk factors — unhealthy diet, lack of physical activity, the use of tobacco and alcohol — which are all on the rise in India. This epidemic is further spurred by factors including a genetic predisposition towards conditions such as diabetes and heart disease, and a sedentary lifestyle, which also brings with it issues such as stress, anxiety, and depression. India bears the dubious distinction of being the diabetes capital with 10.1 Cr. diabetics and 13.6 Cr. with prediabetes. Cardiovascular diseases top the mortality charts, and cancer incidence is projected to rise by 57.5 % by 2040. This health crisis not only affects individuals but also poses a substantial economic burden. The World Economic Forum estimates that India could incur a staggering cost of \$ 4.58 trillion between 2012 and 2030 due to NCDs and mental health conditions.

A resolution for 2024

As India aspires to become a \$5 trillion economy by 2027, the growing incidence of NCDs is a pressing concern. The government has launched initiatives such as the National Programme for Prevention and Control of Cancer, Diabetes, Cardiovascular Diseases, and Stroke, and the 75/25 initiative, the onus now lies on individuals to take charge of their health.

First, we can integrate more natural movement into our daily lives. Just 30 minutes every day can increase cardiovascular fitness, strengthen our bones, reduce excess body fat, and boost muscle power and endurance

Second, we can choose 'slow food' over fast food. Food that is prepared with the ingredients that are right for us and food that is consumed with appreciation.

Third, we can take out a few hours once a year and get a comprehensive health check-up. We need to change our attitude from 'it's better not to know' to 'it's best for me to be proactive so that I can overcome it'.

Fourth, we can make health a dinner table and water cooler conversation.

Winning the war against NCDs is not just vital for individual well-being; it's a decisive factor in safeguarding the health of the nation. By embracing sustainable healthy habits today, we commit to making healthier choices for 365 days and beyond. This resolution transcends personal improvement; it represents a collective dedication to shaping a healthier, more prosperous India.

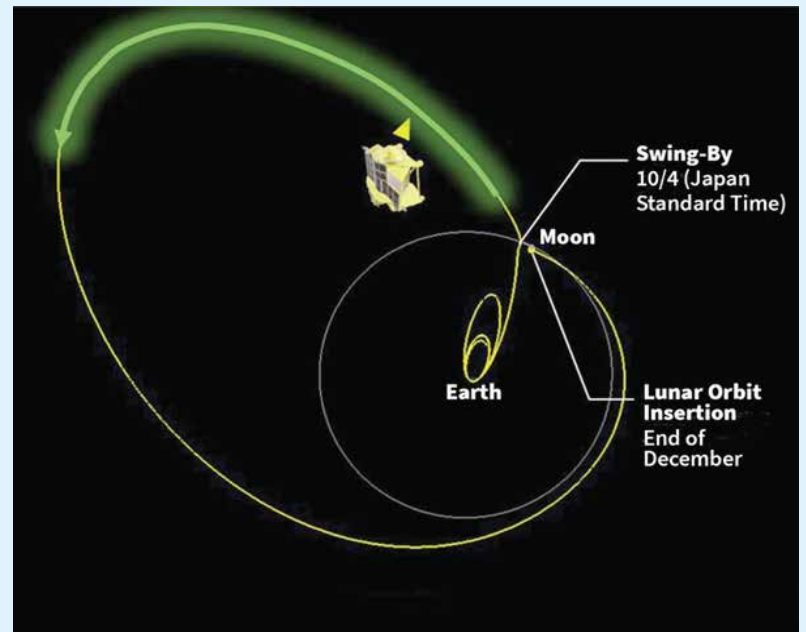
A healthier nation

The power to transform the nation lies in the daily choices of its citizens, reflecting a profound understanding that the well-being of individuals directly impacts the well-being of society. In committing to Resolution 2024, we recognise that small, consistent actions, when multiplied across millions, can generate a seismic shift in the health landscape. It is a call-to-action resonating with the belief that the strength of a nation is rooted in the vitality of its people. As we embark on this journey towards a healthier India, we are laying the foundation for a brighter future for ourselves and for generations to come.

SCIENCE AND TECHNOLOGY

WILL SLIM REVOLUTIONISE LUNAR LANDINGS?

CONTEXT: At 1.21 pm IST on December 25, Japan's Smart Lander for Investigating Moon (SLIM) spacecraft entered into orbit around the moon after a months-long journey, and ahead of its planned moon-landing attempt on January 19. Japan will become only the fifth country to soft-land a robotic craft on the natural satellite, months after India succeeded with its Chandrayaan-3 mission in August.

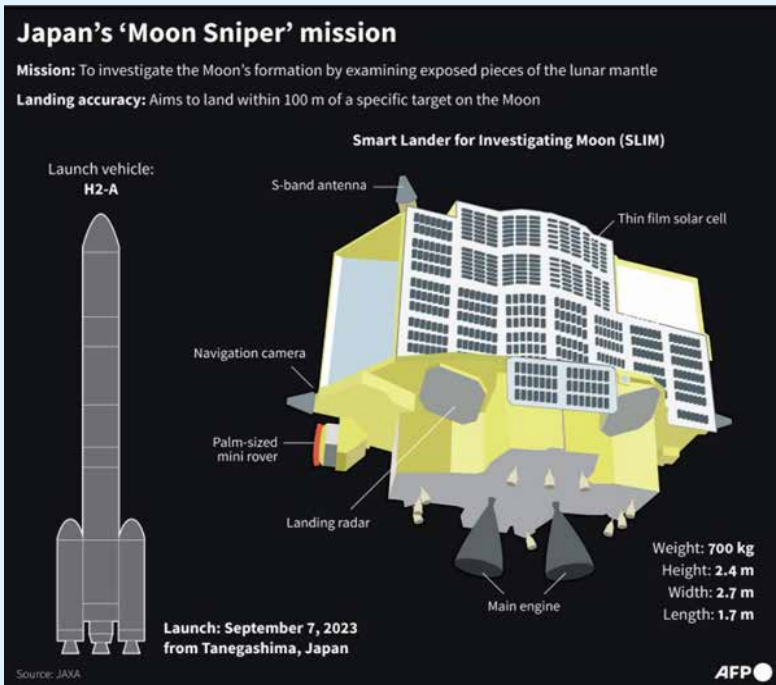


What is SLIM?

On December 25, SLIM entered into an elliptical orbit around the moon over three minutes or so. Its apogee (farthest point) in this orbit is 4,000 km and perigee (closest point) is 600 km above the lunar surface. Japan Aerospace Exploration Agency (JAXA) built and launched SLIM, a spacecraft on September 7, 2023 from the Tanegashima spaceport. It weighed only 590 kg at launch, which is almost one-seventh of Chandrayaan-3, which weighed 3,900 kg at launch.

SLIM was launched together with XRISM, a next-generation X-ray space telescope, onboard an H-2A

rocket. JAXA had planned to launch SLIM and XRISM together, so delays in readying XRISM pushed SLIM's launch date from 2021 to 2023. Notably, JAXA launched SLIM only two weeks after the surface component of India's Chandrayaan-3 mission succeeded and Russia's Luna 25 spacecraft failed. SLIM will also mark the second Japanese attempt this year to soft-land on the moon: the HAKUTO-R M1 lander, built by Japanese company ispace, crashed in late April after its engines shut down too soon during the landing.



How did SLIM get to the moon?

The propulsion module of 3.9 tonne Chandrayaan-3 alone weighed 2.1 tonnes. Chandrayaan III launched on July 14 and could reach the moon less than a month later, by following a route called the Hohmann transfer orbit. On the other hand, SLIM with its lower mass – only 120 kg excluding fuel took four months because it followed a longer but more fuel-thrifty route based on weak-stability boundary theory. Once it was launched into an orbit around the earth, SLIM swung around the planet multiple times, building up its kinetic energy with each swing. Once it was travelling fast enough, it shot up towards the moon's orbit. Chandrayaan-3 followed a qualitatively similar path until this point.

Once it got close to the moon, Chandrayaan-3 applied its brakes – which consume fuel in space – so that it could slow down enough to be captured by the moon's weaker gravity. But once SLIM got near the moon, instead of slowing down and being captured by the moon's gravity, it allowed itself to be deflected in the moon's direction even as it shot past lunar orbit, deeper into space. This deflection is the result of the combined forces exerted by the earth and the moon.

What will SLIM do on the moon?

SLIM was subsequently on a larger, loopier path that was designed to bring it back near the moon in December after it had slowed down further. This event happened on Christmas Day, followed by orbital capture the next day.

By sacrificing some time, SLIM could be more fuel-efficient.

All this said SLIM's standout feature is its reputation as the "moon sniper" – a title derived from what it will do on the moon on January 19: it will try to land within 100 metres of its chosen landing site.

'Vikram' lander of Chandrayaan-3 was designed to descend in an elliptical area that was 4 km long downrange and 2.5 km wide cross-range, and it eventually landed at a spot 350 metres away from a predetermined one. NASA's hulking 'Curiosity' rover was tasked with landing at the centre of a 20 km x 7 km ellipse in Gale Crater on Mars on August 6, 2012, and it landed 2.4 km away. The most precise moon-landing in history was China's Chang'e 3 spacecraft: it landed 89 metres away from its chosen spot in the Mare Imbrium plain on the moon on December 14, 2013. However, it was still allowed to land anywhere inside an ellipse of 6 km x 6 km. SLIM, in effect, will set the record on January 19 for attempting to soft-land with the smallest ever area tolerance on the moon. The chosen site is near the Shioli Crater, at 13.30 S and 25.20 E. Just as the 'Vikram' lander of the Chandrayaan-3 mission used data from the Chandrayaan 2 orbiter to help guide its descent, SLIM will use data from JAXA's SELENE orbiter, which ended in 2009.

Just before it lands, SLIM will deploy two small rovers called Lunar Excursion Vehicle (LEV) 1 and 2. LEV-1, LEV-2, and SLIM will together study the lunar surface near the landing point, collect temperature and radiation readings, and attempt to study the moon's mantle.

How will SLIM affect Chandrayaan-4?

Scientists are interested in the moon's South Pole region at large because parts of some of the craters here are always in shadow, allowing the temperature there to drop very low as well as sparing them the effects of sunlight and diurnal temperature variations. We already know these parts contain water-ice, and a lunar surface mission could potentially explore these sites and attempt to extract water.

When the Indian Space Research Organisation successfully executed its Chandrayaan-3 mission by soft-landing a robotic craft on the moon's surface, on August 23, it also concluded the second phase of its lunar exploration programme. The first mission of its third phase is the Lunar Polar Exploration (LUPEX) mission, a.k.a. Chandrayaan 4.

LUPEX will be an Indian-Japan joint enterprise (however, while JAXA has approved LUPEX, India is yet to) with an earliest launch date in 2026. It will explore an area closer to the moon's south pole than Chandrayaan-3 did – and this makes all the difference.

The terrain near either of the moon's poles is rocky, pocked with several craters, and full of steep slopes. Axiomatically, if there is a suitable landing spot for a (relatively) large landing module or rover, its downrange and cross-range limits will be lower than they were for Chandrayaan-3. The craft will have to land as close to the site as possible, if not at the site itself.

The technologies JAXA will test with SLIM, but especially a feature-matching algorithm and navigation systems, will be crucial for this aspect of LUPEX. For now, JAXA is expected to provide the launch vehicle and the lunar rover while India will provide the lander module. The landing site is yet to be fixed; to compare, the 'Vikram' lander landed 600 km from the South Pole.



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