

EDITORIAL HIGHLIGHTS

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GS 3: AGRICULTURE AND ENERGY THE HINDU PAGE: 07

Biochar offers a way to turn India's farm smoke into 'black gold'

When added to poor, degraded soils, biochar can increase their ability to store water and stimulate the growth of beneficial microbes; studies have indicated that it can improve crop productivity by 10% to 30% and water-holding capacity by 10% to 25%, particularly in soils low in nutrients

Vinaya Kumar H.M.
Vikram Patil

India's agriculture faces a serious paradox: a large amount of biomass that could improve soil health is instead being burned. This threatens soil health and food security. Punjab and Haryana burn more than 20 million tonnes of paddy straw in their open fields every year. This is due to the short post-harvest periods and a lack of practical alternatives.

Burning these residues releases large quantities of greenhouse gases and fine particles into the air and soil, causing serious air pollution in the region as well as a major loss of organic matter that could otherwise be returned to the increasingly depleted soils.

At the same time, large tracts of agricultural land, from the black soils of Maharashtra to the red soils of Kerala, suffer from very low soil organic carbon, poor water-holding capacity, and rapid loss of nutrients, reducing crop productivity even with better seeds and irrigation.

Both these problems are symptoms of the same larger failure to recycle natural resources efficiently.

Value to agriculture

This is where biochar emerges as a carbon negative solution. Biochar is made by heating agricultural waste in low-oxygen conditions. What remains is a carbon-rich material that breaks down very slowly in the soil, helping to keep carbon locked away for long periods of time. The benefits extend well beyond carbon capture. Biochar is highly porous and contributes to aggregating soil particles, holding water, and creating a suitable environment for microorganisms.

Given these properties, the value of biochar to agriculture should be obvious. When added to poor, degraded soils, it can increase their ability to store water and stimulate the growth of beneficial microbes.

Studies have indicated that it can improve crop productivity by 10% to 30% and water-holding capacity by 10% to 25%, particularly in soils low in nutrients.

Biochar derived from maize stalks and applied to black soils in Akola district of Maharashtra has improved soil organic carbon content and overall soil fertility in field trials. Research from Kerala has shown that biochar made from coconut leaf stalks increased soil quality in different cropping systems, emphasising the need to use local resources effectively. Perhaps most significantly, long-term studies have shown that biochar has the benefit of enhancing soil health and maintaining higher crop output over time.

Wider vision

This approach also supports India's wider vision of sustainable agriculture and climate resilience. As droughts,



A biochar mixture ready to be applied to soil. Biochar is made by heating agricultural waste in low-oxygen conditions. What remains is a carbon-rich material that breaks down very slowly in the soil. NAMIBIACBU (CC BY)

heatwaves, and erratic rainfall become more frequent and more intense, improving soil health will be crucial to sustaining agricultural productivity.

By increasing the water-holding capacity and the ability to use nutrients efficiently, thus, biochar can help crops withstand moisture stress while reducing dependency on external inputs. This is particularly important for small and marginal farmers who are often the most exposed to the climate's vagaries.

Integrating biochar into the existing initiatives on natural farming, soil health management, and carbon farming can deliver environmental and economic benefits at scale. Yet in India, biochar remains largely confined to research trials and pilot projects, and is very much alien to many farmers.

In fact, agricultural residues are generally seen only as a problem of disposal. But they are an important resource that can generate additional income, create jobs, can deliver environmental benefits, and could even support payments for ecosystem services.

Carbon credits

As one way forward, the government could package the activities of turning agricultural waste into biochar and putting it on soil into carbon credit markets, creating a strong economic incentive for mass adoption.

Biochar carbon already passes rigorous stability criteria for long-term sequestration, and it can be classified as a persistent carbon dioxide removal technology under internationally accepted accounting standards. For

Biochar is highly porous and contributes to aggregating soil particles, holding water, and creating a suitable environment for microorganisms

instance, VMO042 agricultural land management methodology quantifies both avoided emissions from residue burning and long-term carbon sequestration in soils. In this protocol, each tonne of certified biochar can generate 2.2.8 t carbon dioxide-equivalent in carbon credits. Depending on carbon market prices, certified biochar can thus provide an additional source of income for project developers, farmers, and cooperatives.

This approach is already being tested in projects such as those using the KISAN kiln from IIT-Kharagpur, which allows smallholders to monetise farm waste.

Several international examples also illustrate the scalability of biochar systems. In Kenya, turning rice husks into biochar has produced thousands of certified carbon credits and improved soil pH and phosphorus content. Thailand has pushed biochar use through national initiatives on soil rehabilitation and carbon management, and tied certification to access to the national carbon registry system, providing a policy-to-market pipeline. High carbon retention and large yield gains have also been reported from Brazil's Embrapa Institute after using on-farm biochar generated from sugarcane bagasse.

These examples also show that success

depends on integrated strategies that combine decentralised, appropriately scaled pyrolysis technology with strong measurement, reporting, and verification systems.

Urban organic waste

The feedstock for biochar is also not limited to agricultural waste and can encompass urban organic waste as well. India generates around 62 million tonnes of municipal solid garbage per year and more than 50% of that is biodegradable. Sewage sludge and crop residues can also be converted into biochar.

This is in keeping with the precepts of the circular economy, as organic waste is diverted from landfills that produce methane and is converted to a useful product for agriculture. By systematically implementing these measures, India can turn its large waste streams into 'black gold', thus ensuring a more resilient agricultural future while making a meaningful contribution to global climate mitigation efforts.

Overall, the value of biomass can only be realised through an integrated ecosystem that catalyses innovation, entrepreneurship, market linkages, investment, and cost-effective access to biochar for farmers.

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THE GIST

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GS 2: POLITY THE HINDU PAGE: 10

Can police re-open probe without court approval?

Does Section 173(8) of CrPC permit filing of a supplementary report without Magistrate's permission?

EXPLAINER

R.K. Vij

The story so far:

The Supreme Court recently in *Palniswamy Veeraraja & Ors. versus The State of Karnataka & Anr.* reiterated that the investigating authorities were required to obtain permission from the Magistrate to initiate further investigation after filing the closure report. In this case, the court quashed the First Information Report (FIR) and subsequent chargesheet noting that such permission had not been obtained.

Although an application seeking further investigation had been filed before the concerned Magistrate for a third time, no order granting permission was placed on record, the court said.

The investigating agency had earlier filed closure reports twice, stating that the dispute appeared to be entirely civil in nature. The court also relied on the principles laid down in *State of Haryana v. Bhajan Lal (1992)*, holding that the civil nature of the dispute was an additional ground for quashing the FIR and subsequent proceedings.

Can supplementary report be filed without Magistrate's approval?

The sub-section (2) of Section 173 of the Criminal Procedure Code (CrPC) provides for forwarding a report to the Magistrate after completing investigation in the prescribed form. The Section 173(8) CrPC says that in case the in-charge of a police station finds additional evidence after sending final report to the Magistrate, he may send supplementary report to the Magistrate. It is silent on obtaining permission from a Magistrate for filing

supplementary report under sub-section (8). Section 193(9) of the BNSS is *pari materia* (dealing with the same subject matter) to Section 173(8) of the CrPC.

What has been held by the Supreme Court with regard to further investigation after filing a final report?

The Supreme Court in *Vinay Tyagi versus Irshad Ali (2013)* held that "though there is no specific requirement in the provisions of Section 173(8) of the code to conduct further investigation or file supplementary report with the leave of the court, the investigating agencies have not only understood but also adopted it as a legal practice to seek permission of the courts to conduct further investigation and file supplementary report with the leave of the court".

The court held that the requirement of seeking prior leave of the court to

conduct further probe will have to read into, and is necessary implication of the provisions of Section 173(8) of the code. The court held that the doctrine of *contemporanea expositio* supports such an interpretation, as a practice that has been consistently understood and implemented over time, and is backed by law, should be recognised as an integral part of the interpretative process. This proposition has been approved by the Supreme Court in subsequent cases also.

While the newly added proviso to Section 193(9) of the BNSS (which is *pari materia* to Section 173(8) of the CrPC) mandates that the permission of the court is necessary if the trial has begun, the top court, in *Rama Chaudhary versus State of Bihar (2024)* reiterated that even though the statute does not require express permission, the law has developed and seeking permission from the concerned magistrate is essential. The Supreme Court, in *Robert Lalchungnunga Chongthu v. State of Bihar (2025)*, reaffirmed the ratio in *Vinay Tyagi (supra)*, holding that obtaining the court's leave to file a supplementary chargesheet forms an integral part of the law.

Therefore, despite the new provision of the BNSS, once a chargesheet or closure report has been filed, further probe based on new evidence may be undertaken only with the permission of the court.

R.K. Vij is a former IPS officer.

THE GIST

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GS 3: SCIENCE AND TECHNOLOGY

THE HINDU PAGE: 11

What is Google's Project Nimbus, and why are students protesting against it?

Amazon and Google's Project Nimbus cloud contract with Israel has sparked protests over U.S. Big Tech enabling the Israeli military's violence against Palestinians; the row has intensified internal unrest within companies, with employees raising ethical concerns over how their work is being used

Sahana Venugopal

The story so far:

In June 14, Google CEO Sundar Pichai's speech at Stanford was disrupted as more than 100 students walked out in protest. Some carried Palestinian flags, others draped black-and-white patterned keffiyeh as scarves, and they shouted, "Free, free Palestine!"

The students were protesting against Google's Project Nimbus, a tech contract between the search giant and the Israeli government that is linked with violence against Palestinian civilians.

What is Project Nimbus?

Project Nimbus is a technology contract between the Israeli government and Google and Amazon. It is worth over \$1 billion. In May 2021, Google said the agreement would deliver cloud services to Israeli government entities, including ministries, authorities, and government-owned companies. The project was scheduled to run for an initial period of seven years, and the Israeli government could extend it for up to 23 years. A month later, Amazon said the Israeli government had selected Amazon Web Services (AWS) as its primary cloud provider, under the Nimbus contract for government ministries and its subsidiaries.

In 2024, an investigation by Israeli media outlets +972 Magazine and Local Call found that the country's army stored

information on servers managed by AWS. That data came from the surveillance of Palestinians, as per the investigation. Sources quoted by the media outlets alleged such information could be used to help plan airstrikes.

Furthermore, the outlets reported an increase in Israeli service demands from Google Cloud, AWS, and Microsoft Azure since October 2023, as army units sought data storage and AI services.

Why are protesters against Project Nimbus?

Project Nimbus has been facing backlash since it was first announced. In 2021, an anonymous letter signed internally by 90 Google workers and over 300 Amazon workers criticised the partnership, per The Guardian. They condemned Project Nimbus and the Israeli military's killings of Palestinian civilians, claiming that their employers would be "selling dangerous technology to the Israeli military and government."

The workers claimed that cloud service technology would help expand the surveillance of Palestinians, as well as illegal Israeli settlements on Palestinian land.

Opposition to Project Nimbus has grown since the Hamas attacks against Israeli civilians on October 7, 2023, followed by Israel's airstrikes and blockades in Gaza. In 2024, protesting Google employees even carried out sit-ins at Google locations in the U.S. Later, 28 employees were fired.

Pro-Palestinian protests by employees have also taken place at Big Tech company events, such as during Microsoft's 50th anniversary celebrations in 2025.

Last year, The Guardian, +972 Magazine, and Local Call cited leaked documents revealing that under the Project Nimbus contract, Israel mandated that Google and Amazon would not restrict how its governmental units used the tech companies' cloud services – even if Israel violated their terms of service.

However, Google has in the past stressed that Project Nimbus workloads are not related to the military, weapons, or classified intelligence. Amazon too highlighted its privacy commitments to its customers.

Which other tech companies have links to Israel?

A Palestinian-led movement, called Boycott, Divestment and Sanctions (BDS), has identified large technology companies that have formal contracts with Israel and its military sector.

The BDS website alleges these companies "technologically equip the Israeli military with computing systems as well as surveillance and communications technologies to accelerate the genocide in Gaza and automate apartheid in the West Bank, including East Jerusalem."

In September, Microsoft Vice-Chair & President Brad Smith said the company had "ceased and disabled a set of services to a unit within the Israel Ministry of

Defense (IMOD)." This announcement came after media outlets The Guardian, +972 Magazine, and Local Call reported that the Israel Defense Forces (IDF) was using Microsoft's Azure to store Palestinians' recorded phone calls data that could be leveraged for mass surveillance or even military action.

Did Microsoft truly sever its ties with Israel's defense surveillance systems?

While Mr. Smith said that Microsoft does not provide technology to facilitate the mass surveillance of civilians, he affirmed the company's "important work" to protect the cybersecurity of Israel and other West Asian countries.

In a conclusion to the external investigation that Microsoft commissioned after the Azure surveillance allegations, the tech giant said it would implement better review processes, provide more guidance to employees, and let employees anonymously report potential policy violations.

The No Azure for Apartheid group, which is made up of Microsoft workers, claimed on June 6 that Microsoft still allowed the Israeli military and government to host other surveillance projects on Azure. "Nothing short of cutting all ties with the genocidal Israeli military and government will be enough. We will show up to escalate, confront, and disrupt in every place, at every moment, announced and unannounced," said the group.

GS 3: SCIENCE AND TECHNOLOGY INDIAN EXPRESS

• TECH

Guardrails in AI growth to protect developing nations

Global regulation can help with technology innovation while ensuring that the benefits of AI are widespread and equitable



EXPERT EXPLAINS
B RAVINDRAN

HEAD, CENTRE FOR RESPONSIBLE AI, IIT MADRAS

THE TRANSFORMATIVE potential of artificial intelligence (AI) is becoming increasingly evident, and its impacts are already being felt, touching everything from daily life to broader industries. Consequently, efforts have begun to create global institutions and frameworks to regulate the development and deployment of AI systems.

Some preliminary institutional structures have already been set up. Last year, the United Nations General Assembly established a **Global Dialogue on AI** in which every country has been invited to participate. An Independent **International Scientific Panel on AI** is tasked with making periodic scientific assessments to enrich the Global Dialogue discussions.

Professor B Ravindran, head of the Centre for Responsible AI at IIT Madras, is the only Indian among the 40 people appointed to the Panel for a three-year term. He spoke to **Amitabh Sinha** about the need for a system of global AI governance, why it matters for developing countries like India, and what a commons system for AI tools and resources could look like.

What is the International Scientific Panel on AI supposed to do?

This is the first time a global scientific body on AI has been set up. It is supposed to take a periodic view of the state of science around AI and inform the Global Dialogue on AI.

Our primary responsibility would be to produce reports on the scientific aspects of AI. This body would not get into the politics or policy side of AI discussions. That is the responsibility of the Global Dialogue, in which governments would participate.

Why is a global governance structure on AI needed? Are we moving in that direction?



Visitors at the AI Impact Summit in New Delhi this year. PRAVEEN KHANNA

Personally, I feel that having some kind of international agreement on how AI is to be deployed or the applications we want to use might be useful. As of now, countries are developing their own frameworks to deal with this technology, but that might not be the most effective way forward.

There are two ways of looking at it. One is from the perspective of the development of AI systems. If the regulation is too fragmented, meaning every country has its own set of differing regulations, then the development of AI would also become fragmented. Companies will have to ensure that their systems can adhere to differing sets of requirements in different geographies.

What might happen, as a result, is a possible slowdown in innovation. AI companies might prefer to roll out their services or support innovation only in countries seen as more friendly in terms of their regulations.

At the same time, if some countries begin invoking issues of data sovereignty (seeking control over data originating within their borders) and insist that all AI development and its infrastructure must

• Where AI regulation stands

- Several parallel attempts are being made to regulate the development and deployment of artificial intelligence. Most of these structures have voluntary participation, varying degrees of legal force, and focus on specific aspects like standards, safety and ethics.
- The most comprehensive legal framework for AI is the European Union AI Act of 2024. EU prioritised safe, transparent, non-discriminatory and environmentally friendly AI systems.
- Annual global AI summits, whose most recent edition was held in New Delhi in February, have also resulted in mechanisms that could feed into the development of global governance models on AI.

Would international regulation also control the risks from AI?

There are definite risks, no doubt. People talk about AI's capabilities in building the next generation of biological weapons or the next most powerful chemical weapons. We have international agreements and treaties that control biological or chemical weapons. Now, people might also want to bring about international frameworks that control AI models and the tools that enable these weapons to be built.

While that is logical, the fear and worry are that it might take the shape of non-proliferation language. There might be attempts to propose that only certain countries or companies can develop safe and responsible AI, and therefore, they should be the only ones allowed unrestricted development and use of AI systems. That would lead to something similar to the global nuclear regime.

I am worried about the dialogue on AI moving in that direction. Hopefully, it will not happen, but I think we have to be on constant vigil against it.

You were personally involved in developing the framework for Trusted AI Commons, which was one of the main outcomes of the New Delhi AI Impact Summit in February. What is that, and how would it help?

It can be seen as another part of the global governance structure. The Trusted AI Commons is a repository of various tools needed to develop and deploy AI systems in a safe and responsible manner.

Suppose someone wants to test an AI system meant for agriculture. Trusted AI Commons would be like a one-stop shop to figure out what tools are available to test AI deployment, what the benchmarks, datasets, and even protocols are. Several resources will be housed in the Trusted AI Commons.

To begin with, this Commons will be hosted and managed by India. The India AI mission has to identify a suitable vehicle to do that. Trusted AI Commons will not commission building these tools right away, but many organisations are already working on it. This includes the Centre for Responsible AI at IIT Madras. Companies like Google have also created their own tools. It is called Commons because it will be open, accessible, and with very liberal licensing requirements.



A weekly column decoding AI's new frontiers, how they shape the world and our place in it

Safety and access

AI Commons is being built as a repository of accessible tools, datasets and other resources to test AI systems.

be within national boundaries, it can lead to significant concentration of power. AI-ready, a few countries have the infrastructure and resources to support the entire AI ecosystem.

The other perspective is of deployment. Many countries in Asia or Africa might not have the resources or capacities to frame robust regulations to protect their interests. There would always be a danger of them being reduced to digital colonies.

In this context, having a globally agreed-upon set of minimum regulations would be useful.

AI is a very transformative technology, with a capability of the order of the steam engine. It would be awful if, owing to a lack of regulatory capacities, certain developing countries were denied the benefits of AI. It will be a disservice to humanity at large.

This is why international agreements and arrangements are important. We need to ensure that the interests of countries that are not AI developers themselves are also protected, and they continue to benefit from advancements in this technology.

GS 3: DEFENCE

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• DEFENCE

Three distinct strategic roles of the three ships inducted into Navy

Sushant Kulkarni
Pune, June 21

THE NAVY inducted three ships on Sunday — one that can fight far out at sea, one that can map the sea, and one that can hunt submarines close to the coast.

The three vessels — the Brahmos-armed stealth frigate INS Dunagiri, the deep-water survey vessel INS Sanshodhak, and the Anti-Submarine Warfare Shallow Water Craft (ASW SWC) INS Agray — have been built by Garden Reach Shipbuilders & Engineers (GRSE) in Kolkata. According to the Ministry of Defence, the three together have more than 75 per cent indigenous content, and involve over 200 MSMEs.

What are these three ships?

INS DUNAGIRI: The largest and most heavily armed of the three is INS Dunagiri. It is a frigate, smaller than a destroyer but large enough to operate far from the coast.

It is part of the Navy's Project 17A, under which a new generation of stealth guided-missile frigates are being built in India. Dunagiri carries weapons such as BrahMos surface-to-surface missiles, sensors including Multi-Function Surveillance, Track



PM Modi presided over the commissioning ceremony in Kolkata on Sunday. PTI

And Guidance Radar (MFSTAR), electronic warfare systems and anti-submarine weapons. "At the strategic level, these multi-mission frigates are capable of operating in a 'blue water' environment — deep sea far from shore — dealing with both conventional and non-conventional threats," a serving Navy officer said. Other vessels in the class are **INS NIGIRI** Himgiri, Taragiri, Udaygiri and Vindhyagiri. **INS NILGIRI** not Nigiri **INS SANSHODHAK:** This is a Survey Vessel

— Large (SVL). Its job is to measure and map the sea: the depth of waters, seabed features, approach channels to ports, navigational routes, and oceanographic data. It is equipped with systems such as autonomous underwater vehicles, remotely operated vehicles and multi-beam echo sounders. These help the ship collect data from the surface and underwater.

Warships and submarines do not operate in an empty blue space. They move through waters shaped by depth, seabed features, currents, reefs, channels, ports, underwater slopes and coastal clutter. Knowing this environment helps ships move safely, submarines plan routes, ports update charts, and forces prepare for operations. It also supports civilian needs such as safe shipping, disaster relief, ocean research and coastal development," said a Navy officer who has served on survey ships.

INS AGRAY: The smallest vessel of the three, it has a highly specialised role. Agray belongs to the Arnala-class of smaller warships built specifically to detect and attack submarines in shallow waters near the coast, ports, naval bases and important sea approaches. Agray carries lightweight torpedoes, indigenous anti-submarine rocket

launchers and sonar systems.

"Coastal waters are difficult places to find submarines. They are noisy, busy and cluttered. Fishing boats, merchant ships, seabed features and coastal activity can make submarine detection harder than in the open ocean. That is where ASW-SWGs such as Agray come in," said an officer.

What is the larger message behind commissioning them together?

The importance of Sunday's ceremony is that the three ships add three different capabilities at once.

As the Indian Ocean becomes more contested, the triple-commissioning "is a sign of how the Navy is building capability in layers: big warships for distant operations, survey ships to understand the sea, and smaller submarine-hunters to guard coastal waters," said an officer.

It is also an industrial signal. That three different kinds of ships, with different missions and technologies, can be built domestically and commissioned together shows the growing maturity of India's naval shipbuilding ecosystem.

FULL REPORT ON WWW.INDIANEXPRESS.COM/EXPLAINED

GS 3: ENERGY AND AGRICULTURE INDIAN EXPRESS PAGE: 10

Road to energy security passes through our farms



FROM PLATE TO PLOUGH
BY ASHOK GULATI AND SUBHDEEP BASU

THE WEST Asia crisis has exposed a structural vulnerability in India's growth story: its heavy dependence on imported fossil fuels. Whether it is power generation, transport or fertiliser production, India's energy architecture remains deeply import-dependent. For a fast-growing economy, this is not merely a macroeconomic concern: it is a strategic risk.

But energy insecurity is not India's only challenge. Climate change is increasingly threatening agricultural livelihoods. The forecast of a strong El Niño in 2026 does not augur well for farm incomes. The question, therefore, is not only how India secures its energy future, but also how it builds income resilience for its farmers, who comprise 43 per cent of the workforce. The answer may lie in turning India's *annadata* into *urjadata*, from producers of food to producers of energy, too.

Prime Minister Narendra Modi's push towards renewable energy is commendable. As of March 2026, renewable energy capacity stood at about 274 GW, with solar alone crossing 150 GW. But the model so far adopted in solar energy is mainly large solar parks and PM Surya Ghar. The PM-KUSUM scheme is basically for solar pump sets. This is not sufficient for agricultural transformation. We

lay out below a case for **agrivoltaics on farmers' fields that has potential not only to generate clean energy in rural areas but also to halve the government's power subsidy**, while also increasing farmers' incomes manifold. If promoted by PM Modi on priority basis, it can transform not just agriculture but the very growth story of India. Let us delve a little deeper into it.

Agriphotovoltaics (Agri-PV) integrate solar power generation and crop cultivation on the same piece of land. This allows farmers to harvest both sunlight and crops. **Solar panels are mounted at a height of about 3.5 metres, which permits cultivation beneath them while generating electricity for sale to discoms. The result is dual use of land and dual streams of income.**

Unlike agricultural income, which is vulnerable to weather shocks, pest attacks and market fluctuations, solar income is stable. In effect, solar becomes a "third crop" that provides a dependable source of earnings when conventional crops fail.

ICRIER, with support from Kotak Mahindra Bank's CSR initiative, has created a pilot 600 KW solar plant in Rajasthan. The State Bank of India provided a loan of Rs 1.4 crore, and the farmer himself put in Rs 60 lakh. The project has increased the farmer's income from about Rs 40,000 per acre from wheat and bajra cultivation to nearly Rs 4 lakh per acre through a combination of energy sales and shade-tolerant horticulture, demonstrating a tenfold income enhancement potential.

The significance of Agri-PV extends beyond farmers' income. It also addresses a longstanding distortion in India's power sector. **Agri-culture consumes nearly 2,60,000 GWh of electricity annually, yet pays tariffs far below the actual cost**

Agriphotovoltaics integrate solar power generation and crop cultivation on the same piece of land. Solar panels are mounted at a height of about 3.5m, which permits cultivation beneath them while generating electricity for sale to discoms

of supply. **According to the Comptroller and Auditor General of India's recent report, Steering India's Power Sector Towards Viksit Bharat (2026), the average cost of supplying electricity in India is around Rs 8.5/kWh, and assumed revenue realisation from agricultural consumers close to Re 1/kWh. This implies an effective subsidy of at least roughly Rs 7.5/kWh.** India's annual power tariff subsidy bill is approximately Rs 2.35 lakh crore, with agriculture accounting for roughly 85 per cent. The true cost of power subsidy to agriculture may be even higher as the cost of supply to agriculture is higher than Rs 8.5/kWh, once technical losses, long feeder lines and the costs of maintaining rural distribution infrastructure are taken into account. This would take the farm power subsidy to over 90 per cent of total tariff subsidy. No wonder that, despite repeated reforms and financial bailouts, discom finances remain under severe stress.

Agri-PV offers an opportunity to fundamentally alter this equation. **By generating electricity at the farm level and feeding it into local distribution networks, it reduces transmission losses and infrastructure costs** while transforming farmers from consumers of highly subsidised power into producers of clean energy. However, scaling Agri-PV requires supportive policy. Elevated structures make Agri-PV systems 15-20 per cent more expensive than conventional solar projects, creating a significant entry barrier for farmers.

A differentiated feed-in tariff of say Rs 4.5/kWh, coupled with targeted support under PM-KUSUM, can significantly improve project viability and accelerate adoption. From the perspective of discoms and state governments, such support should be viewed not as an additional subsidy but as a smarter

reallocation of existing expenditure. Even at a feed-in tariff of Rs 4.5/kWh, discoms would be procuring clean power at roughly half the effective cost of supplying power to agriculture. In effect, **every unit of electricity generated through farmer-owned Agri-PV has the potential to reduce the subsidy burden by nearly half while simultaneously creating a new source of farm income.**

The policy implications are clear. Existing support mechanisms under PM-KUSUM Components B and C already provide capital subsidies for standalone solar pumps and the solarisation of grid-connected agricultural pumps. If public support is considered justified for solarising irrigation, a strong case can be made for extending similar support to farmer-owned Agri-PV projects under Component A that simultaneously generate clean energy and preserve farm incomes. Targeted capital subsidies and an attractive feed-in-tariff can be game-changers, and a win-win for the government as well as farmers.

Institutional innovation will be equally important. Just as milk cooperatives transformed India's dairy sector, solar cooperatives can aggregate smallholders, improve access to finance, strengthen bargaining power and manage power sales collectively. Such cooperative institutions can become the vehicle through which the Agri-PV revolution can be unleashed.

If PM Modi takes it up on priority, he can not only transform India but also set an example for the Global South, especially Africa, under the theme of "One Sun, One Earth, and One Grid". That would bring relief from fossil fuels while augmenting farmers' incomes. Can he do that? Only time will tell.

Gulati is distinguished professor and Basu is research fellow at ICRIER. Views are personal

GS 2: INTERNATIONAL RELATIONS INDIAN EXPRESS PAGE: 10

On AI, US & China have an outdated arms race mindset



BHARATH REDDY

OVER THE past few weeks, two governments showed us how they are thinking about AI. Beijing restricted overseas travel for top AI engineers from private firms like DeepSeek and Alibaba. Washington issued a directive to Anthropic to suspend its frontier models for foreign nationals, including its own employees. A commercial product used by millions of people was pulled off the shelf. One country treated software engineers like nuclear physicists, and the other treated a software product like a munition. Both policy actions flow from the same story about what AI is.

National security thinking in the US and China treats AI as a zero-sum arms race or a weapon of mass destruction to be contained through non-proliferation. This narrative has been promoted by frontier labs to gain market share and shape the regulatory landscape. Other policy instruments seen recently, such as export controls and hardware tracking of chips, also stem from this narrative. The framing makes coercion feel like prudence.

However, this analogy misrepresents the technology. Unlike rare, controllable fissile material, AI models are mathematical artefacts that are easily reproducible and constantly diffusing. Chinese firms built competitive models despite chip export controls, and powerful open-source models remain freely downloadable. The bottlenecks to unlocking productivity lie in widespread adoption: Bridging the capability-reliability gap, learning curves, organisational reforms and regulatory compliance.

A more honest framing is the geopolitical innovation race. Here, a dense web of public and private actors across the world compete and collaborate, driven by a mix of national security, economic advantage, and market incentives. The policy instruments that follow are constructive: Compute investment, skilling, industrial policy, strategic partnerships, organisational reforms.

The response for a middle power like India is to lean into AI as a general-purpose technology while acknowledging the geopolitical innovation race. The value lies not just in inventing the frontier but also in diffusing it widely and well. The Supreme Court's draft guidelines on the use of AI tools in courts are a telling example. The returns of the AI era will accrue to the countries that put it to work in health, agriculture, law, and public services.

That points to three priorities. Diffusion over denial: Spend political energy on adoption infrastructure, regulatory clarity, and sector deployment. Plurilateral resilience over self-sufficiency: Coalitions of the like-minded — India and the EU have complementary strengths — can share open-source development costs and build trusted supply chains. Finally, open over closed: The Fable 5 and Mythos 5 suspension shows that dependence on a nationally controlled, closed model risks access being withdrawn overnight. Open-weight models, open standards like RISC-V, and open alternatives to proprietary stacks are resilient because no single government can switch them off.

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