

TAIWAN-INDIA MARINE SCIENCE AND TECHNOLOGY COOPERATION: FROM SCIENTIFIC RECIPROCITY TO STRATEGIC ALIGNMENT

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ABSTRACT

This article analyses the 2024 marine science MoU between Taiwan's National Academy of Marine Research and India's National Institute of Ocean Technology as a move from technical cooperation to strategic alignment in the Indo-Pacific. It situates the partnership within Act East and the New Southbound Policy, reflecting deepening convergence. Cooperation in buoy systems, Indian Ocean processes, cyclone dynamics, and remote sensing links science with security and sustainability. Comparing India's O-SMART and Taiwan's Three Securities and Four Seas frameworks, the study highlights complementary strengths in technology and governance. It argues that marine science now functions as calibrated statecraft, strengthening blue economy collaboration and a rules-based maritime order without formal diplomatic ties.

INTRODUCTION

On November 20, 2024, Taiwan's National Academy of Marine Research (NAMR) and India's National Institute of Ocean Technology (NIOT) concluded a landmark Memorandum of Understanding (MoU) in New Delhi, India¹. This agreement marks the first formal partnership between Taiwan and India in marine science and has been praised as a major breakthrough in advancing Indo-Pacific maritime technological cooperation. The signing took place at India's Ministry of Earth Sciences, attended by prominent figures including Dr M. Ravichandran (Secretary of the Ministry of Earth Sciences), Huang Hsiang-Wen (Deputy Minister of Taiwan's Ocean Affairs Council), and the late Bor-huei Hsieh (Representative of the Taipei Economic and Cultural Centre in India). The MoU carries considerable symbolic weight: it reflects the ongoing Free and Open Indo-Pacific strategic framework, while also highlighting a fresh milestone in strengthening Taiwan-India ties under Taiwan's New Southbound Policy.

Although Taiwan and India have not maintained formal diplomatic ties since 1949, their relationship has gradually advanced over the past three decades. In 1995, they set up reciprocal representative offices in each other's capitals, establishing unofficial channels for interaction.² Entering the 21st century, as India moved forward with its “Look East Policy” in the 1990s, later upgraded to the “Act East Policy”³, and Taiwan implemented the New Southbound Policy in 2016, bilateral engagement in trade, science, and technology intensified significantly. Indian experts have noted that India's Act East Policy and Taiwan's New Southbound Policy share considerable strategic overlap, with both targeting economic, technological, and cultural connections among Asian partners.⁴ In this setting, Taiwan and India have gradually instituted diverse dialogue frameworks — such as the biennial Joint Committee Meetings on science and technology and a wide-ranging memorandum on scientific research signed in December 2023. Taiwan-India relations have displayed “remarkable growth” in areas including trade, investment, science, technology, culture, and education in recent years. In 2024 alone, multiple breakthroughs occurred: a labour cooperation MoU was signed, Indian Prime Minister Narendra Modi and Taiwan President Lai Ching-Te exchanged congratulatory messages, and Taiwan opened its third representative office in Mumbai. These steps have laid a stable groundwork for the current marine technology partnership.

Viewed in historical context, Taiwan-India scientific ties mirror the steady strengthening of overall bilateral relations. Previously, India maintained a “One China” policy to pacify Beijing, limiting official India-Taiwan contact mainly to private-sector engagements.⁵ Nonetheless, non-governmental stakeholders — think tanks and academic institutions — acted as catalysts. For instance, in 2020, the Taiwan-Asia Exchange Foundation (TAEF) and India's National Maritime Foundation (NMF) concluded a memorandum of understanding (MoU) at the Yushan Forum in Taipei, intending to foster dialogue and research on maritime affairs and regional growth.⁶ Officially, Taiwan and India have also formalised multiple agreements since 2019, addressing the realms of economy, investment, agriculture, education, and advanced technology.⁷ These incremental developments highlight a rise in mutual trust and signal that, from a strategic standpoint, India is increasingly regarding Taiwan as a key partner in the Indo-Pacific. Former Taiwanese Deputy Foreign Minister Tien Chung-Kwang similarly stressed that both Taiwan and India serve as pillars of peace and prosperity within Asia's democracies, necessitating fresh avenues for collaboration and coordination to counter security threats such as authoritarian expansion.⁸ Consequently, the

NAMR-NIOT marine scientific research effort represents a timely addition to the evolving Taiwan-India relationship. It not only inaugurates an unprecedented cooperative venture in marine science and technology but also enhances the Indo-Pacific's network of partnerships, strengthening a rules-based order.⁹ By synthesising existing scholarship, this article explores the current trajectory of Taiwan-India marine science cooperation, considers the dual benefits for bilateral research, assesses the geopolitical and economic reverberations, and offers policy recommendations for moving forward.

CURRENT STATE OF TAIWAN-INDIA MARINE SCIENCE AND TECHNOLOGY COOPERATION

Overview of Research Institutions and Fields

Taiwan and India both possess a variety of specialised institutions devoted to marine science, spanning from fundamental oceanography to applied technology. On the Taiwanese side, the National Academy of Marine Research (NAMR) was founded on 24 April 2019, under the Ocean Affairs Council (OAC), serving as a national-level marine think tank that assists the government with marine policy, resource assessment, scientific studies, industrial expansion, and personnel training.¹⁰ Several research centres within NAMR concentrate on distinct areas — marine policy and culture, marine information, marine ecology and conservation, and marine industry and engineering — with the objective of unifying and enhancing Taiwan's marine research capacity in line with global standards and advancing the country's aspiration of becoming a “maritime nation.”¹¹

In India, marine research is supported by a comprehensive and well coordinated network of institutions, with the National Institute of Ocean Technology (NIOT) as a standout example. Established in 1993 as an autonomous entity under the Ministry of Earth Sciences and based in Chennai, NIOT's central aim is to develop reliable indigenous technologies to exploit living and non living resources within India's Exclusive Economic Zone (EEZ).¹² Given that India's EEZ spans roughly two thirds of its land area, NIOT focuses on designing and constructing deep sea exploration vessels, marine renewable energy systems (including Ocean Thermal Energy Conversion and wave energy), seawater desalination facilities, and ocean observing platforms.¹³ Of particular importance is NIOT's development of Low Temperature Thermal Desalination (LTTD) systems in the Lakshadweep Islands

to supply freshwater, alongside anchored and drifting buoy networks that enhance real-time meteorological and oceanographic data collection for improved weather forecasting and disaster warning.¹⁴

Besides NIOT, India hosts other key marine science institutes. Founded in 1966 under the Council of Scientific & Industrial Research (CSIR), the National Institute of Oceanography (NIO) is one of India's oldest such organisations, with its headquarters in Goa and branch offices in Kochi, Mumbai, and Visakhapatnam.¹⁵ Its work spans physical, chemical, geological, and biological oceanography, placing special emphasis on the interaction of monsoonal dynamics and ocean circulation in the northern Indian Ocean.¹⁶ Meanwhile, the National Centre for Polar and Ocean Research (NCPOR), launched in 1998 in Goa under the Ministry of Earth Sciences, specialises in polar research — administering India's Antarctic Programme at the Bharati and Maitri stations, operating the Himadri station and IndARC observatory in the Arctic — and oversees the research vessel ORV Sagar Kanya for expeditions across the Arabian Sea, Bay of Bengal, and broader Indian Ocean.¹⁷ In tandem, NIOT, NIO, and NCPOR constitute an integrated architecture of technology R&D, fundamental marine science, and polar studies, thereby advancing multiple dimensions of India's national ocean agenda.

Main Areas and Highlights of the MoU

Drawing on these institutional resources, the 2024 NAMR-NIOT MoU outlines four principal areas for future joint work, reflecting a shared vision of bolstering Indo-Pacific marine science and technology through targeted collaboration.

- (a) **Development and Application of Buoy Observation Technology.** This domain focuses on ocean-observing buoys and related systems for measuring parameters like temperature, waves, and currents. Taiwan intends to work with NIOT to create a next-generation buoy platform. NIOT has established an extensive network of anchored and drifting buoys that yield real-time data to refine weather forecasts and fisheries projections.¹⁸ Collaboration may coordinate efforts in buoy design, sensor calibration, and data transfer, thereby enhancing the accuracy and durability of both countries' observation infrastructure.
- (b) **Study of Physical Oceanographic Processes in the Indian Ocean.** This area addresses vital processes such as monsoon-related current

fluctuations, thermohaline circulation, air-sea interactions, and inter-basin energy and mass exchanges. Institutes like CSIR-NIO have long investigated the distinctive maritime meteorological features in the northern Indian Ocean,¹⁹ and under this partnership, Taiwanese researchers could join those initiatives while sharing expertise from the South China Sea. Comparative studies — such as examining how sea surface temperature anomalies in both basins influence monsoon strength — promise significant scientific insights.

(c) **Interactions Between Tropical Cyclones and the Ocean.** Focusing on how tropical cyclones form under specific ocean conditions and how cyclones, in turn, modify the marine environment, this theme leverages India’s forecasting expertise and Taiwan’s high-resolution coupled ocean-atmosphere modelling. Joint projects might explore feedbacks like upper-ocean cooling and mixed-layer deepening during cyclones, combining buoy, satellite, and numerical simulation data to improve track and intensity forecasts as well as climate-change projections for cyclone behaviour.²⁰

(d) **Marine Radar and Satellite Observation Technologies.** This domain encompasses coastal high-frequency radars and satellite-based remote sensing. Taiwan has deployed HF radar arrays to detect surface currents and waves, while India’s Oceansat series provides measurements of surface winds, sea surface temperatures, and marine productivity.²¹ Future cooperation could include exchanging technical know-how on radar deployment and jointly planning satellite missions to optimise coverage and share data — extending even to polar seas in line with NCPOR’s interests.

Collectively, these four areas form a broad-based platform to “promote the advancement of marine science research and environmental monitoring technologies in the Indo-Pacific region” while “enhancing technical capacities to drive innovation in marine research for both sides.”²² According to an official NAMR statement, the aim is to “promote the advancement of marine science research and environmental monitoring technologies in the Indo-Pacific region” while “enhancing technical capacities to drive innovation in marine research for both sides.”²³ In essence, the MoU delineates specific cooperative themes and articulates a longer-range objective to strengthen regional marine science and

technology while fostering ecological sustainability in line with international ocean-governance frameworks.²⁴

A Comparison of India’s “O-SMART” Program and Taiwan’s “Three Securities and Four Seas” Policy

Understanding India’s “O-SMART” program and Taiwan’s “Three Securities and Four Seas” policy provides insight into their respective national approaches to marine affairs. “O-SMART” forms India’s primary government plan for marine science and resource management, whereas “Three Securities and Four Seas” represents Taiwan’s integrated maritime governance framework. A comparison reveals that India focuses on concrete technological outputs, while Taiwan emphasises governance and sustainability goals. Below is a concise overview and analysis: India’s “O-SMART” Program: “O-SMART,” an acronym for Ocean Services, Modelling, Application, Resources, and Technology, was initiated in 2018 by India’s Ministry of Earth Sciences. Its current phase runs from 2021 to 2026 with a government allocation of 213.5 billion USD (approximately NTD 82 billion).²⁵ Comprising seven sub-projects — Ocean Technology; Ocean Modelling & Advisory Services; Ocean Observing Network; Ocean Non-living Resources; Marine Living Resources & Ecology; Coastal Research; and Research Vessel Operation & Maintenance — the program is implemented by agencies such as NIOT, INCOIS, NCPOR, CMLRE, and NCCR.²⁶ Its core objective is to sustain ocean observations for weather and climate forecasting, develop key marine technologies, and promote the sustainable exploitation of both living and non-living marine resources. Under O-SMART, India has secured International Seabed Authority approval for deep-sea mining in the Central Indian Ocean Basin, deployed Low-Temperature Thermal Desalination systems on its island territories, and established extensive in situ and satellite-based observation networks from the Arctic to the Antarctic — partnering with the IOC on anchored and drifting buoy arrays to inform fisheries forecasts, storm-surge alerts, and tsunami warnings.²⁷ In sum, O-SMART exemplifies India’s commitment to leveraging scientific innovation as a driver of blue-economy growth through comprehensive national investments in ocean observation, prediction, and resource exploration.

Taiwan’s “Three Securities and Four Seas” Policy: Proposed by Ocean Affairs Council (OAC) Minister Kuan Bi-Ling in 2023, “Three Securities and Four Seas” (三安四海) articulates a comprehensive vision for maritime governance. The phrase denotes “Three Securities” — national security, legal order, and public safety — and “Four Seas” — marine conservation, marine pollution prevention, marine waste management, and marine industry development.²⁸

The “Three Securities” emphasise safeguarding maritime sovereignty, enforcing maritime law, and ensuring public safety; for instance, the Coast Guard Administration operates year-round to deter maritime crime and preserve public welfare.²⁹ A particular focus has been on preventing illegal sand dredging by Chinese vessels and curbing maritime drug trafficking, which saw a zero-tolerance outcome on illegal dredging and a doubling of drug- and firearm-related arrests in 2023.³⁰

Meanwhile, the “Four Seas” directs attention to sustaining and developing marine ecosystems and industries. For environmental protection, Taiwan enacted the Marine Conservation Act in 2023, establishing marine protected areas and wildlife rescue systems.³¹ To control pollution, Taiwan revised the Marine Pollution Control Act and created a Marine Pollution Prevention Fund, improving responses to oil and chemical spills.³² On waste management, Taiwan established a public registry of marine debris removal initiatives and promotes a circular economy for marine waste.³³ To support marine industries, the 2023 Marine Industry Development Act allocates legal backing and resources to grow the blue economy.³⁴

Moreover, the OAC underscores scientific research, making “Marine Science and Technology for Disaster Prevention and National Security” a top priority for 2024.³⁵ In short, “Three Securities and Four Seas” encapsulates Taiwan’s integrated governance approach, combining security with environmentally sustainable growth.

Analysis and Comparison

When set side by side, O-SMART and “Three Securities and Four Seas” highlight contrasting priorities in India’s and Taiwan’s marine strategies. O-SMART chiefly aims at consolidating hard power by generating tangible research outcomes and technological advancements in areas such as observation, extraction, and resource-related services.³⁶ Its successes are measured by the development of new technologies (e.g., deep-sea mining, forecast systems) and enhanced services (e.g., improved meteorological forecasts).³⁷ By contrast, “Three Securities and Four Seas” is a comprehensive framework for governance and principles, tying maritime matters to “national security, legal order, and public safety,” while balancing these with “ecosystem conservation, pollution prevention, waste management,

and industrial development.”³⁸ Hence, India’s approach is more oriented toward scientific research and commercial yields, whereas Taiwan’s centres on institutional coherence, operational capacity, and security–environment equilibrium.

The two strategies also diverge in how they are executed. O-SMART operates as a centralised, government-led initiative, allocating resources and responsibilities to designated national institutes.³⁹ Each sub-project contributes to the broader O-SMART objectives. Conversely, “Three Securities and Four Seas” is a policy paradigm that spans multiple agencies, overseen by the Ocean Affairs Council in collaboration with the Coast Guard Administration, the Environmental Protection Agency, the Ministry of Agriculture, and the Ministry of Economic Affairs.⁴⁰ This arrangement ensures cohesive enforcement across areas like maritime law, ecological stewardship, and industrial expansion. While India’s model helps pool scientific assets for large-scale, technology-centred successes, Taiwan’s approach integrates cross-departmental synergy. Both have their advantages in their respective contexts.

Nevertheless, the two maritime agendas can complement each other. India’s vision for a blue economy addresses sustainability and security — epitomised by Prime Minister Modi’s “Security and Growth for All in the Region (SAGAR),” which has evolved now into MAHASAGAR (Mutual and Holistic Advancement for Security and Growth Across Regions) policy. Meanwhile, Taiwan, guided by “Three Securities and Four Seas,” is gradually elevating research capacity, evidenced by the creation of NAMR and growing recognition of scientific research as a policy pillar. OAC Minister Kuan Bi-Ling has reiterated that the agency will harness scientific innovation to guide policy, propelling marine sustainability.⁴¹ In essence, both strategies ultimately strive for a prosperous, sustainable maritime nation, albeit with differing focal points. The NAMR-NIOT venture aligns with these complementary strengths: scientific and technological collaboration (echoing India’s O-SMART) supports environmental security and industry advancement (mirroring Taiwan’s “Three Securities and Four Seas”). This partnership can thus serve as a demonstration of how Indo-Pacific nations may join forces on maritime governance. According to Hu (2023), worldwide marine affairs are shifting from development toward conservation, urging countries to elevate ocean literacy and pursue international collaboration.⁴² The Taiwan-India partnership exemplifies a shared responsibility for the region’s marine public goods within the Indo-Pacific context.

Bilateral Scientific Benefits

Marine science and technology collaboration between Taiwan and India offers wide-ranging benefits to their research capabilities, ranging from resource sharing and synergy of specialised knowledge to talent training and risk-sharing in R&D. Below, we explore potential mutual gains from the vantage points of data sharing, technology transfer, and personnel exchange.

Data and Observational Sharing

Collaboration allows Taiwan and India to forge a more extensive mechanism for data exchange that bridges the Indian Ocean and the Western Pacific, areas that have largely been studied by separate research communities. As discussed, India maintains a robust buoy observation system and forecasting services, which include anchored and drifting buoys providing fisheries outlooks, storm surge alerts, and tsunami warnings.⁴³ Meanwhile, Taiwan has rich observational records and modelling capacity for typhoons, the Kuroshio Current, and marine carbon dynamics in the Western Pacific.⁴⁴ Integrating these datasets can grant scientists access to wider sources of information, enabling new research that connects oceanic conditions across basins. For instance, comparing ocean parameters from both the Indian Ocean and the Pacific could help elucidate the linkage between *El Niño* and the Indian Ocean Dipole, or trace inter-basin wave activity affecting regional climate.

Such an approach yields fresh perspectives that may be unattainable through regionally isolated research efforts. Moreover, data sharing can reduce overlap in observation systems, allowing researchers to deploy resources in under-monitored sectors⁴⁵. For disaster prediction, India's Indian Ocean temperature and wind field data can bolster Taiwan's typhoon and monsoon forecasting, while Taiwan's Western Pacific inputs can enrich India's long-range climate projections. Officials in India's Ministry of Earth Sciences emphasise that sustained ocean observations and data-informed forecasts are pivotal for disaster preparedness.⁴⁶ By linking their observation networks, Taiwan and India can build a more complete Indo-Pacific marine outlook, offering wider benefits for weather and environmental prediction.

Technical Complementarity and Transfer

A central advantage of scientific collaboration is the reciprocal sharing of technical expertise, tailoring specialised technologies to each side's needs. India and Taiwan possess distinct proficiencies in marine technology that could be harnessed through cooperation. For example, India leads Asia in deep-sea technology. NIOT has designed and tested systems for deep-sea polymetallic nodule extraction, drilling, and submersibles, drawing on years of trial and error.⁴⁷ Taiwan, having devoted comparatively fewer resources to deep-sea mining, can benefit from these lessons in assessing potential involvement in deep-sea exploration in the Pacific's international seabed zone. Similarly, India's expertise in marine renewable energy (e.g., OTEC and wave power) and seawater desalination might prove valuable to Taiwan, especially for sustaining offshore islands.⁴⁸ Conversely, Taiwan holds an edge in precise ocean observation and data science. Its scientific and meteorological bodies have advanced methods for typhoon tracking (including drone-based data), eddy detection, and data assimilation modelling. Indian institutions could adopt these best practices to improve their forecasting systems and computational analyses. Taiwan's well-established ICT industry also brings relevant contributions to marine IoT, data systems, and satellite communications, which can strengthen India's ocean initiatives. By pooling resources, both sides share R&D costs and mitigate the high risks tied to ocean technology innovation. Co-development of specific applications — whether in buoy technologies, remote sensing, or deep-sea exploration — can generate a multiplied benefit for both partners.

Talent Exchange and Development

Marine cooperation also facilitates globalised training for academics, engineers, and students from both countries. Under joint research projects, short- or long-term exchanges of personnel could be arranged, allowing participants to gain firsthand experience in vastly different marine settings. For example, Taiwanese researchers working on Indian Ocean expeditions would observe oceanic features distinct from the Western Pacific, potentially stimulating new lines of inquiry. Conversely, Indian scholars stationed in Taiwan's labs could refine their data analytics and modelling capabilities, benefiting from local expertise.

Such programs nurture a pool of scientists well-versed in both the Indian Ocean and the Pacific, building a foundation for deeper collaboration. These exchanges can

also include governmental or administrative professionals, enhancing institutional links. Over time, such interaction could lead to more permanent frameworks for cooperation, such as a fixed Taiwan-India Marine Cooperation Dialogue. According to OAC Deputy Minister Huang Hsiang-Wen, the MoU encourages “*research, technology exchange, and talent development programs*” on both sides.⁴⁹ In the broader view, talent exchange is not just a matter of individual training; it also secures human capital and networks vital for prospective collaborations of greater scale.

Enhancing Research Capacity and Academic Influence

Collaboration can further elevate Taiwan’s and India’s positions in the global marine science arena. By unifying data from diverse ocean basins and leveraging complementary methodologies, joint research ventures stand a strong chance of producing noteworthy findings. For instance, a paper co-authored by Taiwanese and Indian experts on Indo-Pacific climate interplay could offer more innovative insights than each party operating independently, thereby garnering recognition in major scholarly journals. This visibility enhances scientific reputations and underscores leadership in pivotal areas of ocean research. Joint projects often entail workshops or conferences, allowing either Taipei or New Delhi to serve as hubs for Indo-Pacific marine dialogue, an approach that can be especially advantageous for Taiwan, given its limited role in international bodies. Meanwhile, India is active in organisations such as the Intergovernmental Oceanographic Commission (IOC). Should India and Taiwan present collaborative proposals in such venues, they might garner broader support. Thus, while the scientific collaboration directly furthers research goals, it can also influence diplomacy and regional policy.

Observers suggest that Taiwan’s best path in global marine affairs is to deepen partnerships with maritime nations and international institutions, creating mutually beneficial links.⁵⁰ Working with India contributes to Taiwan’s “maritime diplomacy,” enlarging its role in Indo-Pacific maritime circles. In turn, India gains a reliable partner to advance its profile among the “global South” and other regional participants.⁵¹ As Dr Ravichandran, Secretary of India’s Ministry of Earth Sciences, noted, this collaboration can “*significantly enhance the two nations’ capacities in marine research.*”⁵² Ultimately, it strengthens scientific know-how and better positions both sides to tackle marine and climate-related threats, yielding benefits across the Indo-Pacific and beyond.

Geopolitical and Economic Implications

Taiwan-India cooperation in marine science and technology entails not only research value but also significant geopolitical and economic reverberations. It arises at a time of intensifying Indo-Pacific strategic competition, which will likely draw the attention of key regional actors like the United States, Japan, and Australia, as well as China. The following sections examine how this initiative may shape the wider strategic and economic environment.

Impact on the Indo-Pacific Strategic Landscape

In recent years, the concept of a “Free and Open Indo-Pacific” (FOIP) has been championed by the United States, Japan, India, and Australia to sustain a rules-based regional order and safe maritime channels. Yet, the region’s security structure remains relatively fragmented. Although the Quadrilateral Security Dialogue (QUAD) sometimes functions as a balancing factor against China, it remains focused on non-military collaboration, indicating it is still far from becoming a formal alliance.⁵³ In this setting, bilateral or “minilateral” partnerships can serve as concrete methods of constructing an Indo-Pacific network. Stronger India-Taiwan cooperation adds another layer to FOIP initiatives. The United States, Japan, and Australia may interpret India’s willingness to work extensively with Taiwan as in tune with FOIP principles. An Indian scholar points out that the Indo-Pacific is fundamentally a maritime spatial convergence where India and Taiwan, as principal stakeholders, are jointly responsible for ensuring maritime stability and commercial safety.⁵⁴ Their cooperation resonates with the FOIP objective of safeguarding shared maritime interests. Japan and Australia, known to endorse deeper Taiwanese engagement in regional structures, could welcome this process, possibly seeking a supporting role. For instance, Japan’s advanced ocean monitoring capabilities could blend well with the Taiwan-India partnership, forming a trilateral model. The U.S. and Australia could also contribute funding or expertise, aligning with their broader strategy of uniting like-minded partners in the region.⁵⁵ Some observers note that the QUAD’s efficacy depends on each member’s external partnerships, creating a “*networked security architecture*.”⁵⁶ Even though Taiwan-India collaboration in marine technology is not a military alliance, it still occupies a niche in the Indo-Pacific security mosaic — signalling that countries without official ties can craft functional collaborations to uphold stability and growth.

Potential Influence and Response from China

Such collaboration may trigger a measured response from Beijing, as the People's Republic of China (PRC) asserts sovereignty over Taiwan and objects to any "official" engagement between Taiwan and other nations.⁵⁷ Meanwhile, China's maritime reach, extending from the East and South China Seas to the Indian Ocean, has alarmed multiple regional players.⁵⁸ India-Taiwan cooperation can be viewed as a subtle counterbalance to China's expanding maritime influence. Although Beijing has not formally commented on the NAMR-NIOT partnership, precedents exist. When Taiwan's President Lai Ching-Te congratulated Prime Minister Modi on his re-election in June 2024 — and received a reply — China voiced displeasure.⁵⁹ Similarly, in 2020, China's embassy in New Delhi advised Indian media to refrain from referring to Taiwan as a "country" on Taiwan's National Day, prompting India to reiterate its commitment to media freedom.⁶⁰ This suggests that China remains sensitive to developments between India and Taiwan. One might anticipate China lodging diplomatic protests, arguing that India's move contravenes its declared One China Principle. Still, because the project focuses on science and refrains from official recognition, India retains strategic flexibility. Beijing might choose to weigh this issue against the broader Sino-Indian relationship, already marked by border frictions and strategic rivalry in the Indian Ocean, and respond accordingly. It might opt for restraint so as not to drive India closer to the United States or Japan. Conversely, if China perceives India overstepping on Taiwan-related matters, it could retaliate on other fronts. Overall, though, the initiative underscores an evolving alignment among regional actors with maritime disputes involving China. By cooperating on ocean observations and possibly sharing situational awareness, Taiwan and India could place additional checks on China's maritime operations in the Indian Ocean. While immediate impacts on China's freedom of action may be mild, the symbolic significance is noteworthy. It exemplifies how China's assertive posture in the Indo-Pacific can prompt cooperative responses among regional players lacking formal security ties, contributing to what some analysts term "informal alliances" or "idea-based partnerships" to navigate China's rise.⁶¹

Economic and "Blue Economy" Considerations

Beyond security implications, Taiwan-India collaboration bears economic potential tied to the blue economy and maritime development. Both countries'

economies heavily rely on sea routes and marine resources. Bilateral trade between India and Taiwan in 2023 reached 8.2 billion USD.⁶² More broadly, India maintains substantial commercial links with Japan, South Korea, and other East Asian markets, making the Taiwan Strait and the South China Sea critical arteries for India-bound shipping. Hence, safeguarding these waters is vital for India's trade security. From New Delhi's viewpoint, partnering with Taiwan in marine affairs could supplement its drive to ensure maritime trade routes running eastward. Though the current MoU focuses on science, the resulting trust could later extend to coordinated maritime safety or traffic management. For instance, if crises or severe pollution strike the South China Sea or Taiwan Strait, India might draw on communications and data-sharing networks established via the MoU.

Moreover, the partnership could expand to practical blue economy endeavours. The blue economy model urges responsible ocean resource use to foster economic progress, elevate livelihoods, and conserve ecosystems.⁶³ India's plans include port building, aquaculture, and offshore wind development; Taiwan brings advanced technology and investment potential. Together, the two might support maritime development projects in third countries — like fisheries management or coral reef restoration in nations around the Indian Ocean — earning diplomatic goodwill. This would combine India's regional clout with Taiwan's technical expertise, providing an alternative to China's Belt and Road Initiative. Taiwanese businesses might also consider investing in India's coastal economic hubs or port upgrades, while Indian firms could explore collaborations in Taiwan's marine biotech or offshore wind markets, promoting bilateral investments. India's Sagarmala project aims to modernise ports and logistics, whereas Taiwan is expanding offshore wind, both representing mutually beneficial opportunities. Though economic cooperation is not yet at the forefront of the MoU, some analysts argue that forming a blue economy partnership can yield mutual dividends in South Asia and the Indo-Pacific.⁶⁴ Should the two countries eventually intertwine maritime industry initiatives with research, they could realise tangible gains while also fulfilling environmental and development targets.

Looking ahead, marine cooperation might branch into security or industrial arenas. India and Taiwan could increasingly share maritime intelligence or partner on capacity-building programs under a broader Indo-Pacific framework. As confidence grows, more sophisticated forms of collaboration — such as joint monitoring of naval activities — might be explored, possibly through quiet

channels or with trusted third parties like the US or Japan. The same logic applies to non-traditional security needs, from anti-piracy measures to humanitarian response. In the commercial realm, both stand to benefit by jointly developing port infrastructure, offshore wind, subsea cables, or by working together on high-standard investments in Southeast Asia or Africa. They could also leverage multilateral platforms — such as the East Asia Summit (EAS) or the Indian Ocean Rim Association (IORA) — to amplify their involvement. While Taiwan is not part of IORA, India could relay Taiwanese contributions or invite Taiwan to selected IORA activities. Similarly, Japan, Australia, or the US could be integrated into “Taiwan-India plus X” projects, reinforcing synergy. Such step-by-step progress stands to expand cooperation while keeping political sensitivities in check.

POLICY RECOMMENDATIONS AND FUTURE OUTLOOK

In summary, Taiwan and India have taken a promising step in marine science and technology cooperation, although they operate within a complex strategic environment. To enhance bilateral ties, address potential challenges, and incorporate a wider Indo-Pacific dimension, the following policy suggestions are proposed:

- (a) *Institutionalise Collaboration and Deepen Research Ties.* Both countries should establish a stable, recurrent mechanism under the current MoU.⁶⁵ One approach is a “Taiwan-India Joint Committee on Marine Science,” spearheaded by NAMR and NIOT and including NIO, NCPOR, and related Taiwanese entities like National Sun Yat-sen University or Academia Sinica’s Institute of Oceanography. Annual high-level meetings could appraise ongoing work, set priorities, and align funding. Subgroups could tackle buoy technology, Indian Ocean processes, cyclone-ocean links, and remote sensing. Institutionalisation nurtures long-term trust and ensures consistent budgets. Taiwan could channel support via Executive Yuan science funds or OAC allocations, while India could utilise Ministry of Earth Sciences resources. Under the existing India-Taiwan science accords, marine research should be prioritised.

(b) *Expand Cooperation to Marine Governance and Security.* As joint research matures, it can segue into discussions on maritime governance and security. Authorities such as Taiwan's OAC and India's Ministry of Earth Sciences or Ministry of External Affairs can organise dialogues covering marine environmental protection, fisheries oversight, and maritime law. Initially, these could be "Track 2" gatherings with policy experts, scholars, and businesses, mirroring models recommended by UNESCO's Intergovernmental Oceanographic Commission, and leading to broader agreements like a Marine Affairs MoU.⁶⁶ Such frameworks might include museum collaborations, public ocean forums, or environmental policy exchanges. Non-traditional security collaboration (e.g., joint search and rescue) could develop gradually. Taiwan's Coast Guard has conducted drills with the U.S., Japan, and the Philippines; India's Coast Guard might participate or observe, confronting shared maritime challenges without breaching the One China Principle.

(c) *Mitigate Political Risks Through Low-Profile Pragmatism.* While prospects are encouraging, political sensitivities remain. Both parties should adopt discreet strategies, emphasising the scientific and humanitarian benefits of cooperation.⁶⁷ They can present findings in international scientific bodies like UNESCO-IOC or the World Meteorological Organisation, framing the venture as a contribution to regional and global welfare. India might reaffirm its One China policy while highlighting that non-political engagements with Taiwan are consistent with national interests. Each side should also develop contingency measures in case Sino-Indian or cross-Strait tensions heighten, ensuring that their partnership remains resilient. Taiwan can engage shipping, fishery, and energy stakeholders to reinforce cooperation, while India can encourage think tanks and media to highlight the pragmatic benefits of stronger Taiwan-India ties. A gradual expansion of activities, coupled with careful public messaging, will help sustain the alliance.

(d) *Leverage Synergies with Other Partners.* Taiwan-India collaboration should serve as a pivot for broader Indo-Pacific cooperation. Both sides can invite the US, Japan, Australia, and ASEAN nations to participate in trilateral or "minilateral" frameworks. For example, a "Taiwan-India-Japan" project on ocean observation or a "QUAD+" workshop with Taiwanese specialists could come to fruition. The US may offer financial

or technological support through the American Institute in Taiwan or the Indian embassy's science programs, expanding the collaboration's visibility.⁶⁸ Japan can contribute cutting-edge tsunami monitoring or ecosystem research, while Australia brings expertise from the South Pacific. Taiwan and India could also propose maritime initiatives during the East Asia Summit or within the Indian Ocean Rim Association, aiming to deliver public goods in disaster management or fisheries. Though Taiwan is not an IORA member, India could highlight Taiwanese research or encourage partial participation. Similarly, under the Global Cooperation and Training Framework co-hosted by the US, Japan, and Australia, India might co-sponsor sessions on marine capacity-building. Such multi-party arrangements would bolster the resilience of Taiwan-India projects and enhance their regional clout.

Future Outlook

In the coming years, Taiwan-India maritime science and technology cooperation may well flourish, possibly becoming a linchpin of bilateral engagement. In 2025, both nations celebrate the 30th anniversary of their reciprocal representative offices and could seize this occasion to reiterate their shared vision for a Free and Open Indo-Pacific and eco-friendly maritime progress, showcasing tangible project outcomes.⁶⁹ If progress continues, additional agreements or ministerial visits could arise, providing further momentum. Under ideal circumstances, this collaboration could stand as a model of Indo-Pacific cooperation — demonstrating how entities without formal diplomatic ties can nonetheless create mutually beneficial frameworks in non-political fields. This may encourage others to undertake comparable initiatives with Taiwan, reinforcing its external connections. Of course, uncertainties persist, including fluctuations in the Sino-Indian border situation and cross-Strait relations, as well as potential electoral shifts in both countries. It is therefore crucial to anchor cooperation within institutional and societal frameworks, ensuring continuity beyond short-term political cycles. Observers note that Taiwan-India relations have reached new heights of engagement. The task now is converting this impetus into lasting structures and collective determination for long-range progress. With a clear focus on mutual advantages, along with support from like-minded partners in the region, Taiwan and India are well-positioned to expand cooperation in the Indo-Pacific maritime realm. The outcome would not only benefit their respective

societies but also promote stability and prosperity across the wider region. As some have emphasised, Taiwan, as a maritime entity, should not be marginalised in global maritime discourse. The emerging alignment between Taiwan's maritime aspirations and India's Act East perspective may thus open a valuable window of opportunity: one that could be widened over time, illuminating further prospects for shared gain in the Indo-Pacific.

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