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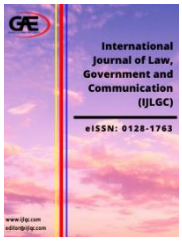

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ADVOCATING THE IMPORTANCE OF MALAY FARMERS' AND FISHERMEN'S ASTRONOMICAL KNOWLEDGE AGAINST THE LIGHT POLLUTION OF MEGA-CONSTELLATION SATELLITES THROUGH HERITAGE DIPLOMACY

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Abstract

Farmers and fishermen in Malaysia traditionally rely on their astronomical knowledge to signify seasons for paddy planting, navigation and choices of fish caught. This knowledge, though, has eroded over time. The installation of mega-constellation satellites by overseas companies brightens the night sky, preventing farmers and fishermen from detecting the stars to guide them. This study's main objective emphasises the relevance of heritage diplomacy in advocating the importance of Malay farmers' and fishermen's astronomical knowledge through relevant initiatives by international and regional organisations to ensure that this legacy lives on for future generations. This is a qualitative study with a socio-legal approach. A textual analysis using interpretivism to interpret provisions among relevant international agreements and reference to non-binding documents that can protect astronomical knowledge and include the participation of farmers and fishermen was conducted. Secondary sources and visits to social media websites and blogs were also conducted and analysed through a content analysis. The result shows that Malaysia can use its foreign embassies to canvas for support for Articles 2 (1), 2 (2) and 2 (3) in the Convention for the Safeguarding of the Intangible Cultural Heritage, Articles 9.1 and 9.2 of the International Treaty of Plant and Genetic Resources, Paragraphs 9.4.2, 10. 2.1 and 12.12 of the Code of Conduct for Responsible Fisheries, the United Nations Educational, Scientific and Cultural Organization's Astronomy and World Heritage Initiative, and the Food and Agriculture Organization's Globally Important Heritage Systems. These relevant articles should be consulted by the United Nations Committee on the Peaceful Uses of Outer Space (UNCOPUOS) so they do not duplicate other initiatives. Malaysia should also advocate for an international agreement or guideline at the UNCOPUOS to control light pollution emanating from

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mega-constellation satellites. A display board showing Malaysian fishermen's knowledge of stars at Tanjung Balau Museum in Johor preserves this heritage. Efforts to ensure the continuity of astronomical knowledge for future generations have included briefing and stargazing trips at the paddy and archaeological museums in Kedah, including the Malay cultural significance of stars showing times for paddy planting and the monsoon season, which prevents fishing in Peninsular Malaysia.

Keywords:

Astronomical Knowledge, Heritage Diplomacy, Malaysia, Globally Important Agricultural Heritage Systems (GIAHS), Code of Conduct for Responsible Fisheries, International Treaty on Plant Genetic Resources (ITPGRFA), Association of Southeast Asian Nations (ASEAN)

Introduction

Malay farmers in Kedah and fisherman on the East Coast of Peninsular Malaysia have traditionally relied on the appearance of certain stars in the night sky throughout the year to indicate suitable seasons for agricultural production or when it is safe to go to sea to catch fish and avoid the monsoon season (Abdul-Hamid, 2015; Dr Singa, 2013; Jaafar and Khairuddin, 2019; "Petua generasi", 2014). Some Malays were indigenous to Peninsular Malaysia, while others can trace their origins to various islands of Indonesia, such as Sumatra, Java, Sulawesi and other neighbouring states throughout Southeast Asia. The Malays also possess traditional knowledge in interpreting stars based on their beliefs and culture to predict suitable times for the planting season, what fish will be available, or signs indicating the monsoon season to avoid going to sea. The term "culture" in this article refers to the "distinctive spiritual, intellectual, emotional and material features that characterize a society or social group [to include] the arts and letters as well as human modes of life, value systems, creativity, knowledge systems, traditions and beliefs" (Association of Southeast Asian Nations [ASEAN], 2000). For this article, the term "traditional knowledge" as used by the United Nations Educational, Scientific and Cultural Organization (UNESCO) refers to "knowledge, innovations and practice of indigenous and local communities" (UNESCO, 2025).

UNESCO asserts that traditional knowledge has developed over time based on a community's experience, tested over centuries of use, adapted to local culture and use, and transmitted orally over generations to include stories, songs, folklore, cultural values, beliefs, rituals, community laws, local language and agricultural practices (UNESCO, 2025). The term "traditional knowledge", according to the United Nations Food and Agriculture Organization (FAO), need not be limited to tribal groups or original inhabitants of an area but refers to all communities that possess local knowledge (FAO, 2004). Since this article focuses on astronomical knowledge, a subset of traditional knowledge possessed by Malay farmers and fishermen who may not necessarily be indigenous people, but whose ancestors may be migrants from neighbouring Southeast Asian countries who inherited long-standing cultural practices, it is therefore more appropriate to use the term "traditional knowledge" rather than "indigenous knowledge". Astronomical knowledge "refers to the understanding and interpretation of celestial phenomena, including the movement of stars, planets and other celestial bodies" (Fiveable, 2025). This means that astronomical knowledge need not be confined to that possessed by indigenous people but can also include that of farmers and fishermen. According to the FAO, "indigenous knowledge systems are often associated with indigenous people thus rather limiting for policies […]" (FAO, 2004).

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Moreover, farmers and fishermen in Malaysia, with their traditional knowledge of using the stars as guides, should be categorised as local communities, since they do not qualify as indigenous people. Interestingly, the Secretariat of the Permanent Forum on Indigenous Issues (CBD Secretariat, 2006, p.2) distinguishes between those who are indigenous people and those falling under the category of local communities by stating "[s]ome local communities may include peoples of indigenous descent." This shows that local communities may include other categories of individuals and are not necessarily limited to indigenous people, although the latter could still be included under this term. Indeed, the Secretariat of the Permanent Forum on Indigenous Issues (CBD Secretariat, 2006, p.2) had asserted that "[l]ong term established rice and fish farmers in Asia may represent another type of local community." Notably, the Convention on Biological Diversity (CBD, 1992) also uses the term "indigenous and local communities" in its preamble and Article 8(j), making a distinction concerning which parties can fall appropriately under which categories. For this article, farmers and fishermen rightly fall under the category of local communities.

Mega-constellation of satellites, basically the installation of groups of satellites that communicate and work together in Low Earth Orbit (LEO) being installed by SpaceX, OneWeb, and Amazon to provide better internet access to remote places on Earth, are creating controversial light pollution among avid astronomers, who find their telescopes images being interrupted by streak of lights (Ciaccia, 2021). Additionally, indigenous people from Australia and Hawaii have voiced their grievances that their dependency on stars has been disrupted, as it is difficult to observe the stars and a dark sky due to light pollution emanating from these mega-constellations of satellites (Amir, 2021; Noon, 2022). The Hawaiian science educator Kai'u Kimura has depended on the celestial sphere and the atmospheric and ocean conditions to guide navigation methods that have been practised for thousands of years (Amir, 2021). Additionally, the Gamilaraay and the Wiradjuri peoples of New South Wales, Australia, refer to "the emu in the sky" to indicate when to hunt for emu eggs and when to stop (Noon, 2022). The Jukurppa or Dreaming of the Martu people of Western Australia, which refers to the seven stars of the *Pleiades,* views the increasing light pollution in the skies by mega-constellation satellites as disrupting this cultural practice (Noon, 2022). In the future, other satellite companies elsewhere, such as China's StarNet GW, Canada's Telesat and even Russia, are set to install more mega-constellation satellites, which will not only cause overcrowding of the LEO but disrupt cultural practices of astronomical knowledge among indigenous people throughout the world (Shepherd 2023; Skibba, 2022). The inability of these indigenous people to use their astronomical practices because of the artificial light pollution caused by mega-constellation satellites has caused them to label this a cultural genocide or astro-colonialism (Ciaccia, 2021). Indeed, the Verge has predicted that around 100,000 operational satellites will be in Earth's orbit by 2030, which is 25 times the current figure (Ciaccia, 2021). This increasing light pollution could be a death knell to indigenous practices of astronomical knowledge.

Because the grim prospect of indigenous people attempting to continue practising their astronomical knowledge had already been highlighted, proposals were made that the preservation of this valuable knowledge be incorporated as part of the Space Legal Framework by a Non-Governmental Organization (NGO) called CANEUS at the 61st Session of the Legal Sub-Committee of the United Nations on the Peaceful Uses of Outer Space (UNCOPUOS) (Pimprikar, 2022). This initiative by CANEUS aims to incorporate indigenous people's astronomical knowledge and lead to a binding agreement or non-binding guideline to acknowledge this cultural practice and secure it from extinction (Pimprikar, 2022). In enabling

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this, CANEUS has stressed the importance of referring to Article 31 of the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP) and Article 8(j) of the CBD (Pimprikar, 2022).

While this initiative should be applauded, this article is critical of the effort to omit the traditional knowledge of farmers and fishermen who, by the current definition, do not belong to the indigenous people, but whose astronomical knowledge as a local community is of profound importance. To be impartial, the UNCOPOUS, if it wants to acknowledge the astronomical knowledge of indigenous people, should also consider farmers and fishermen, as they also possess valuable information about the stars that needs to be preserved and be part of the outer space legal framework. However, the UNCOPOUS could work with the FAO and UNESCO, which already have binding agreements, guidelines and various other initiatives that prioritise the importance and preservation of the traditional knowledge of indigenous people, farmers and fishermen concerning the area of ethnoastronomy. The FAO and UNESCO are well-seasoned in acknowledging traditional knowledge of farmers and fishermen as it pertains to ethnoastronomy, as highlighted in a separate section of this article. Hence, UNCOPOUS could benefit from the expertise of these two organisations, being a newcomer to handling this matter.

Heritage diplomacy, then, plays a crucial role. It is defined as actions by a state to incorporate heritage-related issues into its foreign policy and international relations to build or strengthen diplomatic relations with other states (Čeginskas & Lähdesmäki, 2023; Lähdesmäki & Čeginskas, 2022). This approach to heritage diplomacy is multidisciplinary, combining subjects such as international relations, law, public policy and governance, history and critical heritage studies.

Heritage diplomacy seeks to protect both tangible and intangible cultural heritage from threats, including destruction from war, terrorist attacks, black-market sales of archaeological and historical items, decay due to uncontrolled weather forces, modernisation and technological adoption leading to the neglect of old cultural practices.

Usually, heritage diplomacy is led by high-level officials in a state, often from the Foreign Ministry or the Ministry of Culture and Heritage. They work with their counterparts from other states or international organisations such as UNESCO, whose scope of work includes culture and heritage. Increasingly, cultural and heritage matters involve not only high-level state officials but people-to-people diplomacy from the bottom up, including the participation of NGOs, civil society, curators, heritage societies and many other parties. This is also referred to as international cultural relations (Lähdesmäki & Čeginskas, 2022).

The pioneer of heritage diplomacy, Winter (2015), distinguishes between “heritage in diplomacy” and “heritage as diplomacy”. The first, “heritage in diplomacy”, involves no shared heritage among the related parties for any initiative or projects for collaboration, but one that is coordinated as part of a diplomatic action and policy structure to strengthen diplomatic ties (Winter, 2015). Taman (2023, p. 226) provides an example of “heritage as diplomacy” in action, namely that Indonesia and Malaysia both claim that the *pantun* [verses forming a poem] are integral to their Malay culture since these countries are part of the bigger Nusantara archipelago. Historically, since most Malays in Malaysia originated from the islands of Indonesia, it is not surprising that they brought with them the cultural traditions they inherited

International Journal of Law, Government and Communication
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Volume 10 Issue 41 (September 2025) PP. 457-489
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from their ancestors when they migrated to Malaysia. The *pantun,* though, has undergone subtle changes in Malaysia to suit local conditions. This shared heritage has led to a dispute in which Malaysia and Indonesia each claim the *pantun* as their cultural property, as the country of origin. In 2017, UNESCO decided that the *pantun* should be listed as a joint cultural heritage of both countries (Taman, 2023, p.226).

An illustration of "heritage in diplomacy" is a case in which the European Union (EU) provided foreign aid and expertise to Mali to reconstruct valuable medieval Islamic cultural monuments and refurbish manuscripts (Lähdesmäki, 2021). Although the EU had no shared heritage with Mali, its assistance was provided out of responsibility to preserve a cultural heritage of significant value, as the monuments in Mali had been declared UNESCO World Heritage sites (Lähdesmäki, 2021). This could strengthen the EU's diplomatic ties with Mali; it is also in the EU's interests to fight terrorism since Islamic terrorists were responsible for destroying the monuments.

For this study, the term "heritage diplomacy" will be used in the context of state-level diplomatic initiatives among international countries and regional organisations, entailing collaboration among them to preserve threatened cultural heritage.

Through a country's diplomatic representation at the UNCOPOUS, they can advocate and persuade that the astronomical knowledge of farmers and fishermen should be equally emphasised and preserved, alongside that of indigenous people. This can be done by highlighting work done by the FAO and UNESCO. A country's representative must also raise the concern of light pollution caused by these mega-constellation satellites as a menace and draw the interest of other countries to debate possible solutions to the problem. This might be through a new binding agreement in outer space or a non-binding guideline based on the experience of the FAO and UNESCO, which have dealt with farmers' and fishermen's traditional knowledge on agriculture and fisheries.

Against this background, this study emphasises the relevance of heritage diplomacy in advocating the importance of the astronomical knowledge of Malay farmers and fishermen through initiatives by relevant international and regional organisations to ensure that this legacy continues for future generations. To achieve this goal, Malaysian farmers' and fishermen's traditional knowledge about their interpretation of stars will be stressed. Most of the existing literature on this subject is written in Malay, making it unfamiliar to the outside world. This article consists of a brief literature review, methodology, the Malays' astronomical knowledge in agriculture, navigation and fisheries, the threat of light pollution by mega-constellation satellites, mitigating efforts by private companies and Malaysia to contain light pollution from satellites, an elaboration on UNESCO and the FAO initiatives to recognise the traditional knowledge and practices of indigenous and local communities that may be used to preserve astronomical knowledge, and diplomatic heritage actions by Malaysia and ASEAN to recognise its Malay astronomical knowledge practices. It asserts that the UNCOPUOS fora, besides recognising the astronomical knowledge of indigenous people, must also recognise that of farmers and fishermen so as not to marginalise them, or rich information will be lost for the prosperity of all. Figure 1 below represents a summary of the sub-topics which will be elaborated in this study focusing mainly on the Malay farmers' and fishermen's astronomical knowledge in Malaysia under the threat by the installation of mega-constellation satellites by outer space companies abroad. Heritage diplomacy is regarded as a means to resolve the said

International Journal of Law, Government and Communication
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Volume 10 Issue 41 (September 2025) PP. 457-489
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problem through negotiations by highlighting various initiatives and international agreements by the FAO, UNESCO and ASEAN which can be emphasised by a country's representative among its foreign embassies to deal with the said matter as in Figure 1.

International Journal of Law, Government and Communication
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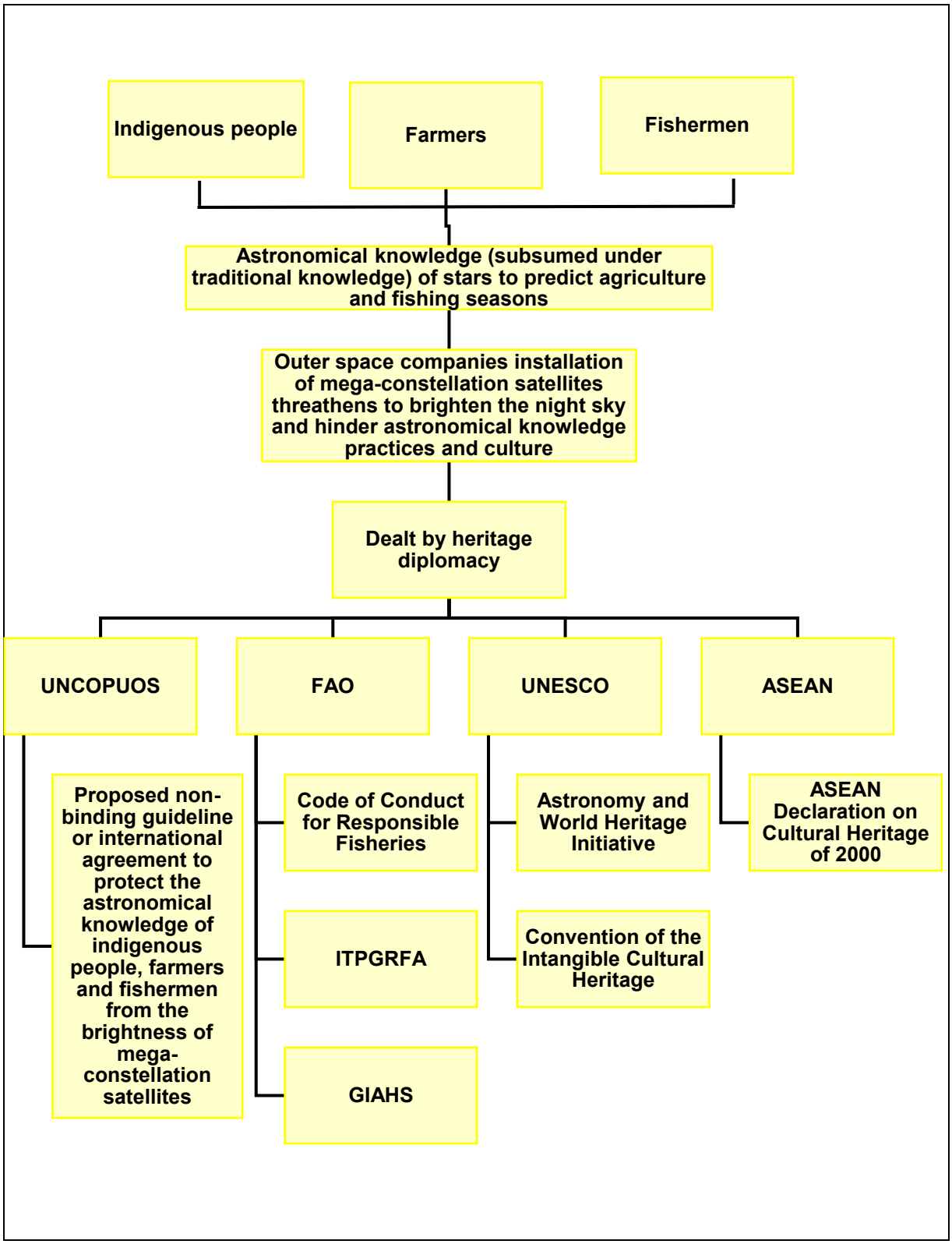

Figure 1: Utilisation of International Agreements and Initiatives to Realise Heritage Diplomacy in Preserving Indigenous People and Local Communities Astronomical Knowledge Practices in Agriculture and Fishing

International Journal of Law, Government and Communication
EISSN : 0128-1763
Volume 10 Issue 41 (September 2025) PP. 457-489
DOI 10.35631/IJLGC.1041030

Literature Review

The controversy concerns the installation of mega-constellation satellites by well-known companies such as SpaceX, OneWeb and Amazon in outer space at LEO, which hinders the detection of stars in the night sky because of excessive light pollution that prevents indigenous people from practising their astronomical knowledge. Its interpretation has been discussed extensively by scholars (Barentine et al., 2022; Berebon et al., 2025; Finnegan, 2022; Noon et al., 2023; Venkatesan et al., 2020). Some of these scholars refer to binding international agreements such as the International Covenant on Civil and Political Right (ICCPR), the Indigenous and Tribal Peoples Convention 1989 of the International Labour Organization (ILO), the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies [thereafter Outer Space Treaty 1967] and the 1972 Convention on International Liability for Damage Caused by Space Objects [thereafter Liability Convention 1972], and the non-binding UNDRIP. The scholars identify provisions that can protect the cultural practices and traditional knowledge possessed by indigenous people from harm caused by light pollution emanating from mega-constellation satellites in the night sky and hold the companies installing these satellites accountable (Berebon, 2025; Finnegan, 2022; Venkatesan et al., 2020). These initiatives have been conducted within the limits of international outer space and human rights law. While it is indisputable that indigenous people's possession and practice of their astronomical knowledge should be protected, this study criticises these scholars' attempts to merely highlight indigenous people's usage of the night sky because they fail to acknowledge that ordinary farmers and fishermen, constituting local communities and not necessarily tribal people of the land, also possess valuable astronomical knowledge. Emphasising the astronomical knowledge possessed only by indigenous people fails to address UNESCO and FAO initiatives that have equally championed traditional knowledge among indigenous people, farmers and fishermen in a broader sense.

This study asserts that migrants who may have been forcibly removed from their native lands can still possess the astronomical knowledge of their ancestors and practise it in navigation and agriculture as local communities in their newfound home abroad in a diaspora. This is true for the Cocos Island Malay migrants originating from various islands in Indonesia and Penang and Malacca in Malaysia, who were brought to this island to work as slaves (Director of National Parks, 2025). Some Malays on Cocos Island in Australia still practice navigation based on the stars using inherited astronomical knowledge from their ancestors (Director of National Parks, 2025). The Malays on Cocos Island are not the indigenous people of the land but are classified as migrants who still maintain their original culture, that of Malays from their homeland of Indonesia and Malaysia, as part of a diaspora community (Director of National Parks, 2025). This demonstrates the error in assuming that the indigenous people of the land are the only ones who practise astronomical knowledge: other local communities that came as migrants can do so as well, based on practices of their own cultures brought from their former homelands. Since previous scholarly writings have only analysed international agreements and non-binding documents within the scope of international outer space and human rights law, this study extends the analysis of the initiatives of UNESCO, the FAO and ASEAN to examine whether farmers and fishermen's traditional knowledge of the stars can find acknowledgement and protection from becoming obsolete. One scholarly work of relevance highlights the Globally Important Agricultural Heritage Systems (GIAHS) of the FAO, which aims to build linkages with local livelihoods, food security, traditional knowledge, cultural values and agrobiodiversity (Niles, 2018, p. 346). This study attempts to determine whether any

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EISSN : 0128-1763
Volume 10 Issue 41 (September 2025) PP. 457-489
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agricultural projects submitted by FAO member countries under the GIAHS initiatives specifically reference astronomical knowledge and its preservation in agriculture.

Within Malaysia, considerable scholarly literature focuses on indigenous peoples' astronomical knowledge associated with the proper times for conducting agricultural processes such as clearing land for planting dry and wet paddy. When the harvesting period occurs among the Ibans, Bidayuh and Dayak in Sarawak and the Kadazan Dusun in Sabah of East Malaysia has also received considerable attention (Ammarell, 2008; Gislen & Eade, 2019; Kadazan Dusun Cultural Association, 2024; Sait, Mersat & Swee, 2018; Tugang et al., 2022). Notably, when presenting the Iban's knowledge of the stars to indicate the various processes of paddy planting, Ammarell (2008) tended to use Western names for these stars, such as *Pleiades, Orion* and *Sirius,* and ignored the names of the stars as understood by the Ibans in Malay. Malaysian scholars who have written about the stars associated with paddy planting in East Malaysia have usually referred to these stars by their original Malay names (Sait, Mersat & Swee, 2018; Tugang et al., 2022). These naming differences demonstrate foreign authors attempting to impose Western terms for the stars on indigenous astronomical knowledge in East Malaysia, as if Western understanding of these stars takes precedence.

Within Peninsular Malaysia, scholarly work documents the different names of stars known among the indigenous people called the *Orang Asli* and their tribes known as the *Semelai* and *Temuan* to indicate the agricultural seasons for planting hill paddy, the suitable time for hunting deer, and the local fruit season (Iszahanid, 2017; Jaafar, 2017). While great attention has been paid to the astronomical knowledge possessed by Malaysian indigenous people in both East and Peninsular Malaysia, scant attention has been given to the same knowledge of the Malays. This is especially true for farmers and fishermen, who generally do not fall under the category of indigenous people *per se* but are more fittingly categorised as local communities. As a politically, economically and socially dominant majority, the Malays cannot be considered indigenous people. Broad UNESCO and FAO initiatives on the preservation of traditional knowledge thus leave room for the Malays' astronomical knowledge about agriculture, fisheries, and navigation to be addressed, as the former term also includes knowledge of local communities.

Zal (2013) indicated that the indigenous people of Peninsular Malaysia, known as *Orang Asli*, are divided into those living on land and the coastline. Zal (2013) researched the *Orang Asli Laut* [indigenous sea people] known as the *Orang Kuala* [mouth of the river people] in Senggarang near the town of Bakar Batu, Johor. Zal (2013) found that the *Orang Kuala* in the past had relied on the stars for navigation when catching fish at night. A similar case is the indigenous sea people in Sabah called the *Bajau Laut* [Bajau sea people], who possessed an ancient sailing scripture called *Kitab Pelayaran Sampang Bulan* [Sampang Bulan's Sailing Almanac] that was found on Bum-Bum Island off the coast of Sabah in 2009 in the hands of Tuan Haji Maharaja Onnong (Ali, 2011). This scripture provides details regarding how the *Bajau Laut* rely on the movement of the moon, stars, earth, wind, waves and sun to guide and influence navigation at sea (Ali, 2016). This ancient scripture was written in a mix of Malay, Arabic and Bajau, and contains various symbols to depict suitable weather, rain and windiness (Ali, 2016). The *Bajau Laut* had relied on memorisation to know particular seasons associated with the appearance of certain stars and celestial bodies (Ali, 2016). It is important to preserve the astronomical knowledge of these indigenous people in Malaysia. However, this study asserts that the Malays, the dominant racial group, whose members also work as fishermen,

International Journal of Law, Government and Communication
EISSN : 0128-1763
Volume 10 Issue 41 (September 2025) PP. 457-489
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equally possess astronomical knowledge on the brink of extinction that needs to be brought to the forefront. This article will therefore delve into various FAO initiatives, in particular the preservation of traditional knowledge among farmers and fishermen. This provides an avenue to salvage their astronomical knowledge, which is also almost obsolete.

One way for Malaysia to put astronomical knowledge preservation at the forefront is to use heritage diplomacy to advocate among international and regional organisations, such as UNESCO, FAO and ASEAN. Heritage diplomacy incorporates heritage-related actions into a state's foreign policy and international relations to help build diplomatic relationships (Lähdesmäki & Čeginskas, 2022). States and regional organisations that have incorporated heritage diplomacy to foster stronger relationships with other states include the EU document "Towards an EU Strategy for International Cultural Relations" and China's 2013 Belt and Road Initiative, whereby cultural diplomacy is featured, while the importance of heritage is subordinate (Lähdesmäki & Čeginskas, 2022). Heritage diplomacy also encompasses the recognition of indigenous knowledge and their heritage practices (Lähdesmäki & Čeginskas, 2022). This approach of merely recognising indigenous knowledge is criticised as it fails to acknowledge farmers and fishermen's traditional knowledge, which can also form an integral part of heritage diplomacy. This study proposes that heritage diplomacy should prefer the term "traditional knowledge protection", as it is broad enough to include the knowledge of other local communities, even though they may not be classified as indigenous people.

A review of the literature has shown that a few states have championed indigenous heritage diplomatically. Shu (2021) has highlighted that Taiwan has pursued a foreign policy that champions indigenous people's rights, especially among the Pacific Island states, since Taiwan's indigenous people, the Ami, share a common language with these islands' indigenous communities to form an Austronesian network. Taiwan has been active in the Austronesian Forum among the Pacific Island states by sending its own Ami people to participate in cultural festivals that emphasise oral traditions and folklore (Shu, 2021). Taiwan has built diplomatic relationships with island states in Oceania by emphasising the importance of tangible and intangible cultural heritage among indigenous communities as a cornerstone of its foreign policy. Moreover, Gallagher (2024) has proposed that Taiwan can also leverage the need to emphasise indigenous people's traditional knowledge in mitigating climate change, which currently threatens some island states of Oceania and their people's livelihood, as central to Taiwan's heritage diplomacy. Likewise, Imam (2024) has proposed that the Commonwealth of Nations can capitalise on the issue of climate change and migration that combines indigenous traditional ecological knowledge with modern solutions as part of the Commonwealth Climate Change Action Plan to build bridges among member states. Again, indigenous people's traditional knowledge has been a useful tool for heritage diplomacy.

Nearer to Southeast Asia, a few events organised in 2025 indicate that ASEAN is equally leveraging indigenous traditional knowledge to mitigate climate change as part of its heritage diplomacy. The Rainforest Youth Summit 2025 (RAYS), held in Kuching, Sarawak, from 18 to 20 June 2025, brought together 700 youths from Southeast Asia, seeking to create awareness among ASEAN youth concerning the importance of indigenous knowledge in addressing the climate change threat to drive environmental action from the bottom up (Sarawak Tourism Board, 2025). Before this, the ASEAN Youth Sustainability Summit 2025, which was organised online from 5 to 9 May 2025 with the theme "Indigenous Knowledge and Global Agenda in Disaster Risk Management and Climate Change Adaptation", was meant to create

International Journal of Law, Government and Communication
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cultural appreciation among ASEAN youth of the virtues of indigenous knowledge in mitigating the harm from climate change since this has long been downplayed to foster fairness and equity (Asia Pacific Youth Service, 2025). ASEAN is also demonstrably leveraging indigenous knowledge issues connected with climate change to strengthen relationships among its members in line with heritage diplomacy under Malaysia's 2025 chairmanship of ASEAN. This is nothing new, as Southeast Asia is rich with its culture and heritage that should be brought into prominence through heritage diplomacy.

While ASEAN should be given credit for bringing the importance of indigenous traditional knowledge to the forefront in the context of climate change, there is still a lacuna in that ASEAN and Malaysia can gain more prominence if endangered astronomical knowledge, constituting part of traditional knowledge, were to feature in their future agendas as part of their heritage diplomacy. This study asserts that this is a neglected area in the context of ASEAN and Malaysia, as a gap exists in underplaying the astronomical knowledge contributions of indigenous people, farmers and fishermen in the areas of agriculture and navigation. This research seeks to explore this further to fill the gap.

Table 1: A Summary of the Literature Review Based on Themes and Its Gaps

Themes	Literature gaps	Authors
Installation of mega-constellation satellites hindering indigenous people from observing the stars and applying their astronomical knowledge and culture.	Does not acknowledge that farmers and fishermen classified as local communities equally utilises their astronomical knowledge of stars to predict suitable agriculture and fishing seasons.	Barentine et al. (2022); Berebon et al. (2023); Finnegan (2022); Noon et al. (2023); Venkatesan et al. (2020).
Identification of international agreements protecting indigenous people's astronomical knowledge has largely focused on the ICCPR, the Indigenous and Tribal Peoples Convention 1989, the Outer Space Treaty 1967, the Liability Convention 1972 & UNDRIP.	Failure to acknowledge initiatives by UNESCO such as the Astronomy and World Heritage Initiative, the Convention of the Intangible Cultural Heritage, the FAO's GIAHS, the ITPGRFA and the Code of Conduct for Responsible Fisheries that seeks to preserve farmers and fishermen's astronomical knowledge linked with culture from extinction.	Berebon (2025); Finnegan (2022); Venkatesan et al. (2020).
Migrants in a diaspora can equally practice their astronomical knowledge brought from their homeland while not being classified as indigenous people of the land in the new country they have migrated to.	No elaboration about migrant farmers and fishermen practicing their astronomical knowledge inherited from their ancestors from their former homeland in the new country of migration to	Director of National Parks (2025).

International Journal of Law, Government and Communication
EISSN : 0128-1763
Volume 10 Issue 41 (September 2025) PP. 457-489
DOI 10.35631/IJLGC.1041030

	predict agriculture and fishing seasons.	
Considerable literature exists concerning the Ibans, Bidayuh and Dayaks in	Limited literature about local Malay farmers or fishermen equally utilising their	Ammarell (2008); Gislen & Eade (2019); Kadazan Dusun Cultural Association (2024);

(continuation)

Themes	Literature gaps	Authors
Sarawak, and the Kadazandusun in Sabah of East Malaysia utilising their astronomical knowledge to predict paddy planting and harvesting seasons.	astronomical knowledge to predict paddy planting and harvesting seasons, or suitable times to fish at sea to avoid storms.	Sait, Mersat & Swee (2018); Tugang et al. (2022).
The *Semelai* and *Temuan* tribes of the *Orang Asli* in Peninsular Malaysia utilising their astronomical knowledge to predict suitable planting seasons for hill paddy, hunting deer and the local fruit season.	Too little emphasis on the Malay farmers in Peninsular Malaysia still practicing their astronomical knowledge to predict suitable paddy planting and harvesting seasons, i.e., the Malay paddy farmers in Kedah.	Iszahanid (2017); Jaafar (2017).
Indigenous people such as the *Orang Asli Laut* in Johor and the *Bajau Laut* of Sabah in East Malaysia have utilised their astronomical knowledge for navigating the sea in assisting them to catch fish.	There is barely much acknowledgement of Malay fishermen's astronomical knowledge of utilising the stars for navigation to predict suitable weather seasons to fish at sea nor determine the type of fish caught.	Zal (2013); Ali (2011); Ali (2016).
Bringing to the forefront the importance of linking traditional knowledge of indigenous people and local communities which includes their astronomical knowledge within the sphere of heritage diplomacy as part of a country's foreign policy.	Scant literature exists concerning Taiwan and the Commonwealth of Nations that have utilised their indigenous people's traditional knowledge in mitigating climate change to make it the cornerstone of their foreign policy objective vis-à-vis other countries to build linkages of commonality. However, the promotion of astronomical knowledge preservation through heritage diplomacy barely receives adequate attention.	Shu (2021); Gallagher (2024); Imam (2024).

International Journal of Law, Government and Communication
EISSN : 0128-1763
Volume 10 Issue 41 (September 2025) PP. 457-489
DOI 10.35631/IJLGC.1041030

Recent initiatives by ASEAN in leveraging on indigenous traditional knowledge to mitigate climate change as part of its heritage diplomacy that focused on the ASEAN Youth Sustainability Summit	While efforts within ASEAN have been made to acknowledge indigenous people's traditional knowledge as a cornerstone for heritage diplomacy, no focus has been given towards	Sarawak Tourism Board (2025); Asia Pacific Youth Service (2025).

(continuation)

Themes	Literature gaps	Authors
2025 that was held online in May, 2025 and the Rainforest Youth Summit in June, 2025 in Kuching, Sarawak to create awareness among youths on the utilisation of indigenous traditional knowledge to curb climate change.	the preservation of astronomical knowledge among indigenous people, farmers and fishermen in the same capacity leaving a gap in this area.	

Methodology

This qualitative study analyses primary sources of documents from relevant international organisations, such as UNESCO, FAO, UNCOPUOS and ASEAN, to determine the extent to which astronomical knowledge among farmers and fishermen within the broader context of traditional knowledge has been addressed. The International Treaty of Plant and Genetic Resources (ITPGRFA) and the non-binding Code of Conduct for Responsible Fisheries within the scope of the FAO contain provisions that address "traditional knowledge". Additionally, a website search was conducted to locate the GIAHS within the auspices of the FAO to identify worthwhile agricultural projects that featured farmers or indigenous peoples' astronomical knowledge being acknowledged and awarded.

This study also referenced the binding UNESCO Convention for the Safeguarding of Intangible Cultural Heritage [hereafter Convention for Safeguarding the ICH] to locate provisions where farmers' and fishermen's astronomical knowledge, passed by word of mouth from older to younger generations, can find protection and preservation so as not to be diminished. This study also tracked the UNESCO Astronomy and World Heritage Initiative website to locate relevant projects on the use of astronomical knowledge by farmers or indigenous people as role models. The same applies to the GIAHS of the FAO. Other resolutions, decision-making documents within UNESCO and the ASEAN Declaration on Cultural Heritage of 2000 were also referenced.

Concerning the UNCOPUOS, no specific binding agreement directly addresses indigenous peoples', farmers' and fishermen's astronomical knowledge. However, this study relied on soft law documents of the UNCOPUOS that mentioned a proposal to recognise indigenous people's astronomical knowledge that was put forward by an NGO called CANEUS. While this marks a significant effort to recognise indigenous peoples' astronomical knowledge, the proposal contains no mention of the knowledge of farmers and fishermen.

International Journal of Law, Government and Communication
EISSN : 0128-1763
Volume 10 Issue 41 (September 2025) PP. 457-489
DOI 10.35631/IJLGC.1041030

The study aimed to understand the threats to indigenous people's astronomical knowledge from the light pollution emanating from mega-constellations of satellites installed by companies such as SpaceX, Amazon, and OneWeb. The study's literature review and results sections draw on the definition of heritage diplomacy, initiatives by international organisations to protect indigenous peoples' astronomical knowledge, and excerpts from newspapers, book chapters, books, journals, conference papers, magazines, and relevant websites.

Website visits to Malaysia's embassies in Austria and Italy and its Permanent Mission to UNESCO in Paris, France, studied the role played by science and agriculture attachés in presenting Malaysia's position to the UNCOPUOS, FAO and UNESCO. Moreover, this study investigated relevant blogs that contain knowledge about the stars and their names in Malay culture to predict suitable agricultural, fishing and monsoon seasons. Normal secondary resources provided Malay astronomical knowledge concerning agriculture and fishing. Such blogs are a form of knowledge sharing by Malaysian individuals who possess knowledge of the stars' functions in Malay culture and are intended to be imparted to future generations so that the information will not be forgotten. Social media accounts such as Facebook were also visited. These accounts post advertisements about talks by local Malaysians on the functions of the stars in Malay culture to signify suitable seasons and times for paddy planting. Such talks represent impromptu efforts to impart almost obsolete astronomical knowledge to interested parties.

A document analysis was conducted on non-binding documents from the UNCOPUOS, UNESCO, FAO and ASEAN. A textual analysis interpreting relevant provisions in the ITPGRFA, the Convention of ICH, and the CBD was also conducted in line with legal hermeneutics. This socio-legal research combines research methods in the social sciences and law.

A content analysis was conducted on the secondary sources mentioned above to identify emerging themes to serve as relevant subheadings in this article.

Results of the Study

The study results appear below.

Malay Farmers' and Fishermen's Astronomical Knowledge about Agriculture, Navigation and Fisheries

At the Fisherman's Museum at Tanjong Balau in Johor, attempts to document fishermen's knowledge of the stars resulted in the museum displaying a board describing each star's functions. Table 1 presents a brief description of each star and its functions:

Table 2: Stars Indicating Suitable Times for Fishing, the Type of Fish Caught and the Monsoon Seasons

Star Name	Functions and Characteristics
Bintang Lunga (known by the *Temuans*) The *Tika* Star The *Pleiades* *Bintang Kerochong* (known by the *Semelai*)	• Consists of seven stars arranged in a row. • Rises alternatively with the *belatek* star in certain months, but cannot be seen in June.

International Journal of Law, Government and Communication
EISSN : 0128-1763
Volume 10 Issue 41 (September 2025) PP. 457-489
DOI 10.35631/IJLGC.1041030

	• Rises around 3.00 a.m. and is associated with the habits of the fish, specifically the "tamban" fish that wait collectively at an artificially made "unjang-unjang", consisting of coconut leaves and branches from the tamarind tree, which are subsequently put into the sea with something to weigh them down to attract the fish.
Belatek Star *Orion's* Belt, or the Three Kings or Three Sisters *Bintang Pèh* (known by the *Semelai*)	• Consists of three stars in the shape of a triangle. • Will rise one month after the *tika* star, used as a guide by fishermen to return to land and to determine the Muslim *qibla*. • The rise of this star indicates strong winds will occur without rain. The star rises from around December to May. • The winds will be strong, signifying a rough, choppy sea.
Tukoh Star	• Consists of seven stars arranged in a necklace. • Normally sighted in November and appears from the east. • Brings heavy rains and strong winds for a long time.
Kelambu Star	• Consists of four stars in the shape of a square. • Appears in December. • Brings continuous strong winds and heavy rains to cause floods along the East Coast of Peninsular Malaysia.

Source: Abdullah (2017); Dr Singa (2013); Teh (2021).

In Marang, Terengganu, the *Bintang Tujuh beradik* [seven stars], alternatively known as the *tukoh* star, signifies the monsoon season on the East Coast of Peninsular Malaysia, making it unsuitable for fishermen to cast their nets at sea, as it is too dangerous. The Malays call the monsoon season *Musim Tengkujuh* because of the appearance of the seven stars. ("Petua generasi", 2014). The attempt to document and preserve Malay fishermen's traditional knowledge of the stars at the Tanjung Balau Museum must be applauded, as it seeks to impart useful information to foreign tourists and the Malaysian public about an almost extinct practice and heritage. The Fisherman's Museum is unique in Malaysia. Efforts to impart such traditional knowledge to interested parties can be improved if state governments on the East Coast of

International Journal of Law, Government and Communication
EISSN : 0128-1763
Volume 10 Issue 41 (September 2025) PP. 457-489
DOI 10.35631/IJLGC.1041030

Peninsular Malaysia are willing to organise fishermen to conduct guided public tours at night, sharing their knowledge about the different types and functions of these stars with the younger generation to continue this legacy. Moreover, these knowledgeable fishermen can conduct training courses so that young fishermen can obtain certification organised by the state government of the East Coast of Peninsular Malaysia.

Other stars in the Malay lexicon include the *bintang pagi* or *bintang seang* [morning star], which comes out just before daybreak from the east, almost where the sun rises (Mohamad, 2016). The morning star is also known as *Kejora* (Abdul-Hamid, 2021; Mohamad, 2016). The Malays' astronomical knowledge guiding their sea passage is legendary and is acknowledged in the historical document *Undang-undang Laut Melaka* [Maritime Laws of Malacca]. A *malim* [guide] should know the intricacies of sailing, including the astronomical knowledge concerning the position of the moon and stars, which have significant meanings (Othman, Mohd-Hanafiah & Hassan, 2014, p. 3009). All the knowledge about stars passed down by Malay fishermen is contained in oral traditions, considered an intangible cultural heritage under the UNESCO Convention on the ICH.

Moreover, the Malays in Kedah have used the *Bintang Tujuh* [seven stars] constellation to signal the changing seasons in their calendar, the *piama* ('seasons') (Jaafar & Khairuddin, 2019). The *piama* depends on the wind direction or the monsoon. The altitude of the seven stars indicates the different stages for paddy planting, as listed below.

1) *Menatang benih* [to carry seeds] or *guling padi* [to roll seeds] is when the *Pleiades* cluster reaches 30° above the eastern horizon.
2) *Menerbit* [to rise] is when the seven stars appear just over the horizon.
3) *Melongsor gelang* [to slide the bracelet] is when the seven stars reach 60° above the horizon.
4) *Mengangkat kening* [to raise the eyebrow] or *rembang* [zenith] is when the seven stars reach 90° above the horizon.
5) *Condong* [tilted/slanted] is when the seven stars move down about 30° from their zenith.
6) *Asar* [late afternoon] is when the seven stars are about 30° above the western horizon.
7) *Jatuh* [to fall] is when the seven stars set below the horizon (Jaafar & Khairuddin, 2019).

During the process of carrying seeds or rolling the paddy, farmers hold the paddy seeds in their palms and sow them by scattering them. The right time to sow the paddy seeds is from *menatang benih* until the *mengangkat kening* (Jaafar & Khairuddin, 2019). When the seven stars subsequently appear at the height of *menatang benih* in the eastern horizon after sunset, this shows the beginning of harvesting in the next phase of *Piama Dua* [Season Two].

The type of paddy seeds to be planted also depends on the brightness or dimness of the seven stars at the top of its tail. If the star cluster is dim at the top while it shines brightly at its tail, the time is ideal to plant red paddy, known as *padi berat* [weighty paddy], which can withstand heavy rainfalls. White or yellow paddy seeds are sown if the star cluster is light and luminous at the top but dim at its tail to suit a drier season rather than heavy rainfall (Abdul-Hamid, 2015,

International Journal of Law, Government and Communication
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Volume 10 Issue 41 (September 2025) PP. 457-489
DOI 10.35631/IJLGC.1041030

p. 181). White and yellow paddy seeds are considered *padi ringan* [light paddy] (Jaafar & Khairuddin, 2019).

To help familiarise the Malaysian public with the significance of the stars and their timing for paddy planting, an association of astronomers called Sahabat Langit Utara (SALUT) organised a briefing and presentation entitled *Bintang Tujuh, Tinggal Enam* [Seven Stars, Six Left] at the Paddy Museum, Gunung Keriang, Alor Setar, Kedah, on 29 November 2024, in conjunction with camping activities (SALUT, 2024). This briefing and camping trip aimed to educate participants about the presence of the *Bintang Tujuh* [seven stars] that appear at dusk to signify the yearly season for paddy planting. This event also aimed to teach the participants that the *Bintang Tujuh* is normally associated with the Western version of its name, *Pleiades* (SALUT, 2024). Additionally, the appearance of the *Bintang Tujuh* signals the East Coast monsoon in Peninsular Malaysia, which is also known as the *Angin Timur* [East Wind] (SALUT, 2024). A previous event to promote knowledge of the stars linked with Malay culture, called *Menyingkap Peta Bintang dan Khazanah Buruj Melayu* [Unveiling the Star Map and Treasures of the Malay Constellations] was held at the Archaeological Museum of Lembah Bujang in Kedah on 9 May 2025 to attract fans of astronomy, teachers and tour guides (Jaafar, 2025). More such events are needed to ensure that the astronomical knowledge related to paddy planting among the Malays will survive the ongoing challenges of the increasing closure of paddy fields in rural areas of Malaysia.

The Threat of Light Pollution from Mega-Constellation Satellites

The number of satellites being launched into outer space continues to increase, exacerbating artificial light pollution. As of 2025, Orbiting Now indicates 12,952 satellites are orbiting Earth, with 145 satellites newly launched this year ("Top 10 nations", 2025). The United States (US) alone accounts for 8,530 satellites in orbit from the National Aeronautics and Space Administration (NASA), the Department of Defence and commercial players such as SpaceX's Starlink project, Amazon's Project Kuiper, and Iridium ("Top 10 nations", 2025). The Starlink project alone accounts for 7,400 satellites, offering global internet services that target hard-to-reach places such as mountains, hills and islands with remote communities, where setting up information and communication infrastructures may be impossible for governments ("Top 10 nations", 2025). Starlink plans to deploy 12,000 satellites in its first phase and a total of 42,000 satellites ("Satellite mega-constellations", 2025). In July 2023, Starlink's satellite broadband was made available in Malaysia, the sixtieth country to be served by Elon Musk's broadband services (Yeoh, 2023). Amazon's global aim is to deploy 3,236 satellites, including for underserved areas ("Satellite mega-constellations", 2025).

The UK has 763 satellites in orbit as of March 2025, meant for military, intelligence, scientific research, and communications with OneWeb, a privately owned satellite company planning to launch 648 LEO broadband satellites in remote regions ("Satellite mega-constellations", 2025; "Top 10 nations", 2025).

So far in 2025, China has launched multiple missions, including CERES-I, Guowang broadband constellation launches and its Long March 6A missions ("Top 10 nations", 2025). China has increasingly seen private players, such as iSpace and Galaxyspace, also wanting to launch satellites to rival those of Starlink, Amazon and OneWeb ("Top 10 nations", 2025). Guowang plans to launch 13,000 satellites ("Satellite mega-constellations", 2025).

International Journal of Law, Government and Communication
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Volume 10 Issue 41 (September 2025) PP. 457-489
DOI 10.35631/IJLGC.1041030

Projections predict up to 100,000 satellites in orbit, contributing to light pollution and sending radio signals that may negatively affect indigenous peoples', farmers', and fishermen's astronomical knowledge, as the brightening of the night sky will prevent them from seeing the stars and other celestial bodies to practice their culture (Skibba, 2022). Just one mega-constellation satellite is responsible for producing 19 parallel light streaks that disrupt telescope images (Noon, 2022). In 2021, the Zwicky Transient Facility at Palomar Observatory, near San Diego, discovered that 18% of the photos taken contained satellite streaks compared to less than 0.5% two years earlier (Skibba, 2022). Thus, the optical and infrared trails and radio transmissions posed by these satellite constellations represent a threat to astronomical observations through telescopes. They may prevent the detection of asteroids and comets that may collide with Earth, requiring scientists to give early warnings for mitigation strategies (Skibba, 2022). Astronomical observations can handle light pollution to approximately 10% of skyglow, but beyond this threshold, it is impossible to conduct scientific observations of the sky (Shepherd, 2023).

The brightening of the night sky due to light pollution caused by these mega-constellations will be the death knell for indigenous peoples' astronomical knowledge embedded in and communicated through stories, songs, dance and poems tied to stars and other celestial bodies. The obstructed view of the stars would mean they could not practice their culture and pass on their knowledge to future generations. According to Jennifer Howse, a member of Métis Nation of Alberta Region 3 and an education specialist, "[t]eaching the motion and meaning of stars, planets, and the moon in the night sky is lost when the younger generation cannot see the stars" (Noon, 2022). If astronomical knowledge is already becoming extinct because of the adoption of new technology in agriculture and fisheries in the modern era, light pollution will only hasten its demise. The Malays possess astronomical knowledge about the paddy planting season; their fishermen also rely on this valuable information to navigate and determine suitable seasons to avoid the monsoon and safely go to sea. This means farmers and fishermen are also users of the night sky, like the indigenous people, whose rights are also affected. Thus, astro-colonialism, or the domination of the night sky by capitalist satellite companies, impedes astronomical knowledge practices and may lead to the destruction of cultural practices. This "cultural genocide" resulting in the inability to see stars and other celestial bodies applies not only to indigenous people but also to other local communities that consist of ordinary farmers and fishermen throughout the world.

Private Companies and Malaysia's Efforts to Mitigate Light Pollution from Mega-Constellation Satellites

When SpaceX first launched its mega-constellation satellites in 2019, the company was soon criticised, as its satellites caused light streaks in telescope images and the night sky became brighter (Mortillaro, 2022). In response, SpaceX attempted to reduce the reflectivity of its satellites through an anti-reflective coating and shielding called DarkSat and VisorSat (Morrison, 2022). This coating technique has helped reduce the reflectivity by 50%, but not all light wavelengths can be reduced through this means (Noon, 2022). On the other hand, OneWeb opted to launch fewer satellites than initially proposed at higher altitudes to produce less sky glow (Noon, 2022). SpaceX, though, refused to relocate its satellite to a higher altitude, for fear that this might impede Starlink's network speed and latency.

International Journal of Law, Government and Communication
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Volume 10 Issue 41 (September 2025) PP. 457-489
DOI 10.35631/IJLGC.1041030

Moreover, the Inter-Agency Space Debris Coordination Committee has suggested a non-binding guideline to lower a satellite's orbit when it becomes non-functional, to enable it to disintegrate as it falls to Earth (Noon, 2022). Currently, light pollution caused by private satellite companies cannot be addressed adequately because of a non-existent binding agreement, creating a lacuna in this area.

On 3 February 2022, the International Astronomical Union (IAU) formed the Centre for the Protection of the Dark and Quiet Night Sky from Satellite Constellation Interference (Mortillaro, 2022). This new centre will collect data from professional and amateur astronomers using their telescope images to help identify streaks of light caused by light pollution. Another group at this centre will work with companies, urging them to build satellites that are less reflective and avoid radio frequency disturbance (Skibba, 2022). The third group at the centre will make national and international policy recommendations. The fourth group is tasked with community engagement, seeking input from indigenous people, environmentalists, astro-tourism groups, the planetarium community and other parties regarding means to limit light pollution and preserve dark, quiet skies (Skibba, 2022). Notably, input from farmers and fishermen, who also constitute local communities using the dark skies to locate stars in connection with their astronomical knowledge, has not been sought.

The more significant challenge to Malaysia now is light pollution emanating from the mega-constellation satellites being installed by private entrepreneurs worldwide to achieve better internet access in remote places. Nevertheless, the inability of indigenous people, farmers and fishermen to access the night sky to practice their astronomical knowledge due to light pollution from mega-constellation satellites does not receive much attention in Malaysia.

In 2016, Malaysia's then National Space Agency, known as Angkasa [now called MYSA], asked the country to draft a new Light Pollution Act since its observatory at the National Planetarium in Kuala Lumpur could not conduct its work because of increasing light pollution ("New law to control", 2016, p.2). An observatory was built on Langkawi Island in 2006 ("New law to control", 2016). The secluded and remote island was better for observing the skies at night than Kuala Lumpur, the dense capital city with nighttime hustle and bustle, which was vulnerable to light pollution ("New law to control", 2016). The outcome, on 6 July 2025, was a guideline rather than a binding law, to take effect in 2026 (Hakim, 2025). This guideline aims to minimise artificial lighting at night in support of astronomical observations and formulate a sky brightness index, especially in dark sky areas identified by observatories, campsites and astro-tourism zones in Malaysia (Hakim, 2025). Most importantly, drafters of this guideline have urged that studies be conducted to gauge the impact of light pollution on human health, economic development, wildlife habitat and cultural heritage (Hakim, 2025). Disappointingly, the only practice named as being affected by light pollution of the night skies is the Islamic religious practice of sighting the moon for the fasting month of Ramadhan, Eid al-Fitr, when Muslims celebrate after one month of fasting and welcome the month of Syawal (Hakim, 2025). This article asserts that the astronomical knowledge practices of other ethnic or racial groups based in Malaysia should also be considered, even though they may be animistic, such as those of indigenous people and the Malays, whose majority are still fishermen and farmers. The astronomical knowledge of these ethnic groups deserves equal attention, as all races are equal in Malaysia and none can be marginalised.

International Journal of Law, Government and Communication
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DOI 10.35631/IJLGC.1041030

International Initiatives to Address the Astronomical Knowledge of Indigenous People and Local Communities

International initiatives by UNCOPUOS, UNESCO and the FAO to address the importance of indigenous and local communities' astronomical knowledge are presented below.

The UNCOPUOS Initiatives

In April 2024, the International Institute of Space Law (IISL) reported to the UNCOPUOS on light pollution and the night sky from a space law perspective (Committee on the Peaceful Uses of Outer Space, 2024). The IISL acknowledged that light contamination from mega-constellation satellites impacts the culture and ceremonies of indigenous communities, as a brightening sky prevents them from locating the stars and other celestial bodies (Committee on the Peaceful Uses of Outer Space, 2024, p.3). The IISL also refers to the non-binding 2007 UNDRIP, which contains provisions emphasising the cultural rights of indigenous people to practice their knowledge of stargazing (Committee on the Peaceful Uses of Outer Space, 2024, p.6). The IISL referred to UNESCO's efforts to protect astronomical heritage sites, but not to the binding Convention of the ICH, which can preserve traditional knowledge (Committee on the Peaceful Uses of Outer Space, 2024). The IISL's efforts have again neglected any initiative by the FAO to address farmers and fishermen's traditional knowledge or preserve their astronomical knowledge indirectly through the binding ITPGRFA, the Code of Conduct for Responsible Fisheries and the GIAHS initiatives. This may be a deliberate refusal to recognise that farmers and fishermen's traditional knowledge involves the stars, or sheer ignorance that these neglected groups in other parts of the world are also users of the night skies. In either case, it is of grave concern. Malay farmers and fishermen possess astronomical knowledge despite not necessarily being indigenous people of their land. This case study is presented to inform relevant parties about these people's rights to practice their culture.

Therefore, the UNCOPUOS should engage with the Secretariat of UNESCO and the FAO to support all initiatives, soft law and binding agreements to protect and preserve indigenous peoples', farmers', and fishermen's astronomical knowledge while being fair to all affected parties and without marginalising anyone.

Efforts at UNESCO to Recognise Astronomical Knowledge

Efforts to recognise local and traditional knowledge of indigenous people and local communities and its association with science resulted with the Declaration on Science and the Use of Scientific Knowledge and Science Agenda – Framework for Action, which was the outcome of the 30th General Assembly of UNESCO that was held in Paris, France from 26 October to 17 November 1999 (UNESCO, 2000). Section 3.4 of the Annex to the Declaration states that:

> *Governmental and non-governmental organizations should sustain traditional knowledge systems keepers and developers of this knowledge, their ways of life […] their social organization and the environment in which they live […]* (UNESCO, 2000).

This means that governments worldwide must ensure the continued sustenance and survival of indigenous peoples' and local communities' traditional knowledge so that this valuable information does not become extinct.

International Journal of Law, Government and Communication
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Volume 10 Issue 41 (September 2025) PP. 457-489
DOI 10.35631/IJLGC.1041030

Moreover, traditional knowledge is precious and not to be taken lightly, as it must be linked with science in conjunction with the scope of UNESCO's work. A relevant quote from the Declaration of 1999 supports this:

> *Governments should support cooperation between holders of traditional knowledge and scientists to explore the relationships between different knowledge systems and to foster interlinkage of mutual benefit* (UNESCO, 2000).

Another document produced by UNESCO, entitled "Local Knowledge, Global Goals" (Nakashima et al., 2017, p. 28), acknowledges the traditional knowledge of local communities in observing and interpreting meteorological phenomena to gauge suitable times for planting and harvesting and times and locations for hunting, fishing and gathering. This shows that UNESCO recognised indigenous and local communities' knowledge of the stars and other celestial bodies, and provided interpretations of their appearance in the night sky to signal the beginning time for agriculture or when to avoid a monsoon season, when fishermen are unable to reap their bountiful catch from the sea. Furthermore, traditional knowledge does not remain static and is bound to change and be enriched by indigenous and local communities with changes and the adoption of technology (Nakashima et al., 2017). Most importantly, in 2002, UNESCO launched its Local and Indigenous Knowledge Systems programme (LINKS).

In 2003, a pilot study commenced to identify relevant sites associated with astronomy as part of the Global Strategy for a more equal representation World Heritage List that did not leave out important astronomical sites (Cotte & Ruggles, 2010). This led to a proposed UNESCO's Astronomy and World Heritage Initiative at the 28th Session of the World Heritage Committee (Cotte & Ruggles, 2010). Simultaneously, from 17 to 19 March 2004, an expert meeting concerning "World Heritage and Monuments of Astronomy" was organised by UNESCO's Regional Bureau for Science in Europe (ROSTE) (Cotte & Ruggles, 2010). Then, at the 29th Session of the World Heritage Committee in 2005, Decision 29 COM 5B requested "the Director of the World Heritage Centre to further explore the thematic initiative 'Astronomy and World Heritage' as a means to promote, in particular, nominations which recognised and celebrate achievements in science" (UNESCO, 2005). This led to the following criteria for cultural property associated with astronomical heritage:

i) Properties by their concept and/or environmental situation are significant in connection with celestial objects or events;
ii) Representations from the sky and/or celestial objects or events;
iii) Observatories and instruments;
iv) Properties with a crucial link to the history of astronomy (Cottee & Ruggles, 2010).

In October 2008, UNESCO and the IAU signed a Memorandum of Understanding (MoU) to collaborate on implementing and predicting the progress of the Astronomy and World Heritage Initiative. This led to the creation of a Working Group on Astronomy and World Heritage to fulfil the responsibilities in the MoU (Cotte & Ruggles, 2010). Moreover, in 2007 a *pro bono* initiative called the Declaration in Defence of the Night Sky and the Right to Starlight proposed to inform the World Heritage Committee at its 31st session held at Christchurch, New Zealand on the need to have "Starlight Reserves", quiet and remote places for people who are interested in astronomy to observe the stars and other celestial bodies away from light pollution coming from busy cities (Starlight Initiative, 2007, p.6). Subsequently, this led to the formation of the

International Journal of Law, Government and Communication
EISSN : 0128-1763
Volume 10 Issue 41 (September 2025) PP. 457-489
DOI 10.35631/IJLGC.1041030

Working Group on Starlight Reserves and World Heritage in 2009 to study the need to establish "starlight reserves" worldwide (Cottee & Ruggles, 2010). Another milestone included UNESCO and the IAU declaring 2009 as the International Year for Astronomy (Cotte & Ruggles, 2010). The realisation of the Astronomy and World Heritage Initiative promotes both tangible (physical buildings, monuments, stone carvings, wall paintings, scriptures) and intangible cultural heritage (knowledge passed down by indigenous and local communities by word of mouth from generation to generation) to complement one another. A physical object is useless without the history and background normally obtained through an informed person well-versed in its past through oral communication. Under UNESCO's Astronomy and World Heritage Initiative, the social issues of astronomy were emphasised to include indigenous and local communities' creation of their calendars, navigation, agricultural practices related to the stars, moon and other celestial bodies.

A use of stars that has become tangible and intangible cultural heritage, as highlighted by UNESCO, is the case of the Aflaj Irrigation Systems of Oman (Nash, 2010). In this case, the stars were and still are used to guide farmers in timing irrigation (Nash, 2010). This knowledge of the stars is handed down orally by the elders and farmers, and ethnographers. A manuscript from Al-Hamra by Sheikh Said bin Saleh Al-Abri is part of the rare documentation detailing the names of the main stars and when they appear (Nash, 2010). This document is an example of tangible heritage, while the oral tradition handed down by the elders to younger generations about different stars is one of intangible cultural heritage. Regretfully, the use of the stars has almost become extinct. The knowledge is dying a natural death with the elderly, while younger generations are not enthusiastic to learn this valuable information (Nash, 2010). Although few of the elderly still possess the knowledge about the stars, the younger generations need the elderly to guide them in making correct predictions about the stars. Notably, UNESCO has acknowledged that increasing light pollution has made the practice of observing the stars in Oman more difficult, causing this practice to diminish (Nash, 2010).

Indeed, the installation of more mega-constellation satellites in the future will contribute to artificial light pollution that will further brighten the skies, making it impossible for farmers in Oman to stargaze and continue their traditions. Examples of buildings for observing the stars include those at Al Fath and in Zahib (Nash, 2010).

This example makes it clear that when it comes to the preservation of farmers and local communities' astronomical knowledge, UNESCO takes a broad approach in including these groups without specifically limiting cultural preservation practices to indigenous people.

Moving forward, the 2018 IAU General Assembly in Vienna, Austria, formed the Ethnoastronomy and Intangible Heritage working group to record, preserve, and safeguard indigenous and traditional knowledge pertaining to astronomy (Hamacher et al., 2022). The scope of work includes oral traditions (stories and narratives), music (song and dance), knowledge systems, cultural practices (such as navigation practices and ceremonies), and artistic representations, arts and crafts, which are both tangible and intangible.

The 2018 initiative aims to obtain UNESCO's heritage recognition, preservation efforts through government and regulatory initiatives, reducing light pollution, education and conducting recordings whenever permissible through storytelling, songs and dance (Hamacher et al., 2022).

International Journal of Law, Government and Communication
EISSN : 0128-1763
Volume 10 Issue 41 (September 2025) PP. 457-489
DOI 10.35631/IJLGC.1041030

Most crucially, UNESCO has a binding international agreement known as the Convention on the ICH. Article 1 (a) of the Convention for Safeguarding the ICH explicitly states that its purpose is "to safeguard the intangible cultural heritage" while Article 1 (b) seeks "to ensure respect for the intangible cultural heritage of the communities' groups and individuals concerned". Article 2 (1) of the Convention for Safeguarding the ICH defines intangible cultural heritage as including "practices, representations, expressions, knowledge, skills – as well as the instruments, objects, artefacts, and cultural spaces associated therewith – that communities, groups and, in some cases, individuals recognize as part of their cultural heritage". Article 2 (2) of the Convention for Safeguarding the ICH indicates that intangible cultural heritage is manifested in oral tradition and expressions, including language, performing arts, social practices such as rituals and festive events, knowledge and practices concerning nature and the universe, and traditional craftsmanship. Efforts at "safeguarding" are embedded in Article 2 (3) of the Convention for Safeguarding the ICH to encompass "identification, documentation, research, preservation, protection, promotion, enhancement, transmission, particularly through formal and non-formal education as well as the revitalisation of the various aspects of such heritage". Based on this, UNESCO's international agreement, farmers and fishermen's astronomical knowledge can be protected as knowledge and practices concerning nature and the universe. Provided that a state party has ratified the Convention for Safeguarding the ICH, all parties concerned are obligated to enforce this binding international agreement. Article 11 (b) of the Convention for Safeguarding the ICH obligates state parties to "define the various elements of the intangible cultural heritage present in its territory, with the participation of communities, groups and relevant NGO's". Hence, this subsection demonstrates that work to acknowledge and calls to preserve the traditional knowledge of farmers about astronomy and agricultural practices can be protected under UNESCO's Astronomy and World Heritage Initiative and the binding Convention of the ICH.

FAO's Initiatives in Recognising and Preserving Farmers' and Fishermen's Astronomical Knowledge

This subsection examines the FAO Code of Conduct for Responsible Fisheries in its promotion of preserving fishermen's traditional knowledge concerning information about the stars to assist them in their fishing activities. Paragraph 6.4 of the Code states that "[c]onservation and management decisions for fisheries should be based on the best scientific evidence available, also considering traditional knowledge of the resources and their habitat, as well as relevant environmental, economic and social factors. […]" (FAO, 1995). By using the term "traditional knowledge", the FAO seeks to expand indigenous people's knowledge and that of local communities to include fishermen.

Paragraph 12.12 of the Code also asserts that:

> *States should investigate and document traditional fisheries knowledge and technologies, in particular those applied to small-scale fisheries, in order to assess their application to sustainable fisheries conservation management and development* (FAO, 1995).

This indicates that states must preserve any form of traditional knowledge that fishermen may possess, including their astronomical knowledge that assists them in navigating the sea, or finding an area full of a particular type of fish or knowing when to avoid the monsoon season. The state should conduct conservation efforts so that this precious knowledge does not die out and will be passed to future generations. To enable this, the fishermen's astronomical

International Journal of Law, Government and Communication
EISSN : 0128-1763
Volume 10 Issue 41 (September 2025) PP. 457-489
DOI 10.35631/IJLGC.1041030

knowledge can be documented for safekeeping in a book, a video or podcast documentary interviewing the fishermen, or a display board documenting this astronomical knowledge and placing it in a museum for visitors to scrutinise.

To ensure that these fishermen's astronomical knowledge will not become extinct, individuals are needed who are willing to learn from elderly fishermen. The elderly would pass on this precious information to the younger generation to be practised. As a means of doing this, the Code in Paragraph 9.4.2 indicates that:

> *States should promote the creation of public awareness of the need for the protection and management of coastal resources and the participation in the management process by those affected* (FAO, 1995).

Indeed, the need to create public awareness regarding the requirement to preserve the fishermen's astronomical knowledge can be imparted to the public by placing such information on display boards at museums, creating brochures or bringing the public on guided tours at night on fishermen's boats to experience the knowledge first-hand. This can spark public interest in seeking more valuable information.

Recognition of farmers' traditional knowledge in the area of agriculture through a binding international agreement can be found in Article 9.1 of the ITPGRFA, which reads:

> *The Contracting Parties recognize the enormous contribution that the local and indigenous communities and farmers all regions of the world, particularly those in the centres of origin and crop diversity, have made and will continue to make for the conservation and development of plant genetic resources which constitute the basis of food and agriculture production […]*(ITPGRFA, 2001).

Article 9.2 of the ITPGRFA specifically asserts the responsibility that national governments have in realising farmers' rights to plant genetic resources, which is subject to national legislation to promote to include "protection of traditional knowledge relevant to plant genetic resources for food and agriculture". Notice that Article 9.2 of the ITPGRFA explicitly refers to and recognises farmers' traditional knowledge without hiding it under the ambit of local communities. Farmers' traditional knowledge is equal to and equally acknowledged as that of indigenous people. Thus, a farmer using astronomical knowledge to decide which type or colour of paddy to plant is a form of traditional knowledge to be protected, as the continued planting of paddy seeds ensures a pool of plant genetic resources for the future.

Furthermore, the FAO has the GIAHS, which was formed in 2002 to acknowledge and preserve the traditional knowledge of indigenous people and local communities, especially their agricultural practices that can contribute to food security (Howard et al., 2008). The FAO designated the Chinampa Agricultural System of Mexico City under GIAHS in 2017 (Government of Mexico City, 2017). The Chinampas were artificial islands built around shallow lake areas of the Valley of Mexico, where the Aztecs had used their knowledge of the stars, moon, and sun to gauge optimal times for planting and harvesting (Government of Mexico City, 2017). These observations of celestial bodies were made using structures like temples and observatories (Government of Mexico City, 2017). Under the International System for Agricultural Science and Technology – AGRIS of the FAO, a project that uses the weather

International Journal of Law, Government and Communication
EISSN : 0128-1763
Volume 10 Issue 41 (September 2025) PP. 457-489
DOI 10.35631/IJLGC.1041030

and climatic knowledge of farmers in the southwestern Free State of South of Africa was commenced. It relied on farmers' observations of constellations of stars, animal behaviour and other traditional forms of indications (Zuma-Netshiukhwi, Stigler & Walker, 2013). Another worthy project under GIAHS is the Mayan milpa system practices in Yucatan, Mexico, which is a traditional rotating farming method for maize, beans and squash (Secretariat of Sustainable Development, 2012). The milpas, which are cultivated plots, depend on the movement of stars and other celestial bodies in determining optimal planting times (Secretariat of Sustainable Development, 2012). The astronomical knowledge of the Mayans in Yucatan has been passed down to future generations (Secretariat of Sustainable Development, 2012). Observation of these celestial bodies determined suitable planting times, which seeds to choose from, and the harvesting season. Thus, such traditional knowledge must be preserved, as its loss could contribute to food insecurity, poverty, declining livelihoods and biodiversity disappearance.

Malaysian Actions to Be Enforced Internationally Through Heritage Diplomacy

Since the astronomical knowledge of farmers and fishermen has been highlighted, Malaysia's science and agriculture attachés at its embassies in Austria and Italy should raise this matter, or it will continue to be ignored. As the FAO's main office is in Rome, Malaysia's agricultural attaché in Italy should canvas the importance of farmers' and fishermen's astronomical knowledge to be preserved under GIAHS. Furthermore, Malaysia's Permanent Representative to UNESCO in Paris can propose that Malay farmers' and fishermen's astronomical knowledge is a crucial cultural heritage that deserves to be acknowledged under the Astronomy and World Heritage Initiative. Hence, Malaysia has numerous opportunities through its science and agriculture attachés at its embassies to further its interest in having its farmers' and fishermen's astronomical knowledge recognised. Although Malaysia can voice its grievances directly to the UNCOPUOS, UNESCO and FAO for ignoring farmers and fishermen's astronomical knowledge, it would be better to raise this concern as a unified party to ASEAN, which has more influence to put forth views as a regional organisation. The preamble of the ASEAN Declaration on Cultural Heritage of 2000 [hereinafter ASEAN Declaration] addresses potential threats of light pollution emanating from mega-constellation satellites, since this could be part of a development process or from the forces of globalisation. An excerpt from the preamble of the ASEAN Declaration reads as follows:

> *Fully aware of the threat of cultural loss, rapid deterioration of living traditions of creative and technical assistance, knowledge systems and practices […] due to tropical climate, inappropriate development efforts […] or the homogenizing forces of globalization […]* (ASEAN, 2000).

It is beyond ASEAN's control to prevent satellite companies abroad from installing mega-constellation satellites, since outer space can be freely explored by any country as the common heritage of mankind. However, ASEAN collectively can make its position clear to the UNCOPUOS that some form of binding agreement or guideline must be initiated to limit light pollution emanating from mega-constellation satellites since this causes the brightening of night skies that threatens the astronomical knowledge practices of indigenous people, farmers and fishermen.

Moreover, Paragraph 1 (d) of the ASEAN Declaration, dealing with the scope of cultural heritage, makes it clear that indigenous knowledge systems and practices need to be protected. The ASEAN Declaration is criticised for using the term "indigenous knowledge", which

International Journal of Law, Government and Communication
EISSN : 0128-1763
Volume 10 Issue 41 (September 2025) PP. 457-489
DOI 10.35631/IJLGC.1041030

implies mere protection of this ethnic group, instead of using the term "traditional knowledge", which is broad enough to include farmers' and fishermen's astronomical knowledge.

Paragraph 3 concerning sustentation of worthy living traditions in this ASEAN Declaration (2000) outlines steps to be taken to preserve cultural heritage, such as:

> *[…] ASEAN Member Countries shall design both formal and non-formal learning programs for living traditions, both rural and urban settings […]*(ASEAN, 2000).

As Malaysia already has some maritime and agricultural institutions, and universities offering related courses, it would be appropriate to offer a course emphasising the fishermen's and paddy farmers' astronomical knowledge on navigation and paddy planting seasons. This could include their astronomical knowledge practices to be imparted to future generations and preserved as a cultural heritage from becoming obsolete, in line with the ASEAN Declaration.

Furthermore, paragraph 3 of the ASEAN Declaration (2000) also requires parties "to institute a system of awards and recognitions for the living bearers of worthy living traditions or human living treasures". In this regard, Malaysia and other ASEAN members could identify those of the elderly community still practising the astronomical knowledge in the area of agriculture and fisheries who could impart this knowledge to the younger generations, by formally organising talks, training sessions and practical know-how and reward the elderly for championing a good cause.

Additionally, paragraph 12 of the ASEAN Declaration (2000) stresses the need to create awareness among political and economic leaders concerning cultural factors, including the cultural industry and tourism. This study suggests organising cultural tours to paddy fields or guided tours on fishermen's boats at night, where those with astronomical knowledge can share their knowledge in navigation, detecting and catching fish.

Thus, ASEAN can voice a unified concern about light pollution by mega-constellation satellites to the UNCOPUOS. Individual member states can also take measures to protect the astronomical knowledge possessed by their farmers and fishermen based on the ASEAN Declaration on Cultural Heritage.

Conclusion

The main objective of this study was to emphasise the relevance of heritage diplomacy in advocating the importance of Malay farmers' and fishermen's astronomical knowledge through relevant initiatives of international and regional organisations in ensuring that this legacy lives on for future generations. Malay farmers and fishermen, who are classified as local communities, rather than being known as indigenous people, use knowledge of the stars, a form of astronomical knowledge, to indicate the different times and processes of paddy planting according to varying seasons, for navigation, and to determine the types of fish available at sea. The astronomical knowledge possessed by the Malay farmers and fishermen, which is part of greater traditional knowledge, is in danger of becoming extinct because of modern technology adoption in farming and navigation and sheer ignorance, which renders old practices obsolete.

International Journal of Law, Government and Communication
EISSN : 0128-1763
Volume 10 Issue 41 (September 2025) PP. 457-489
DOI 10.35631/IJLGC.1041030

Malaysian paddy farmers and fishermen who still practice their astronomical skills of stargazing now face over-brightening skies at night with the growing installation of mega-constellation satellites. This is where heritage diplomacy can play a role: Malaysia's science attaché at its embassy in Vienna, where the UNCOPUOS is based, and its agriculture attaché in Rome, where the FAO is located, can advocate for a binding agreement or at least a guideline that would monitor the conduct of private companies charged with installing mega-constellation satellites to find ways to decrease light pollution. Since Malaysia has its own Permanent Representative to UNESCO in Paris, it would be feasible to raise the same concerns to UNESCO and to discuss possible solutions with other member states, as this international organisation's portfolio already handles the intersection between astronomy and world heritage. Malaysia's attachés in these foreign countries can also argue that relevant provisions also exist in the Convention for Safeguarding the ICH, ITPGRFA, and the Code of Conduct for Responsible Fisheries to preserve the astronomical knowledge of farmers and fishermen as highlighted in this article. At the regional level of ASEAN, Malaysia should raise the concern that mega-constellation satellites cause light pollution in Southeast Asia. Speaking as one voice through ASEAN would be more effective as it shows a solidified position among a group of Southeast Asian countries that are willing to champion the astronomical knowledge of their indigenous people, farmers and fishermen in preserving their cultural heritage, now facing manmade threats of satellites in the night sky.

In conclusion, emphasising heritage diplomacy at the international level can help to address the threat posed by mega-constellation satellites, whose installation is set to increase. If Malaysia, ASEAN, UNESCO, the FAO and UNCOPUOS do not assert strong pressure to address light pollution from brightening skies, this will sadly lead to the demise of practising astronomical knowledge among the indigenous peoples and local communities mentioned and a loss of cultural heritage. Therefore, advocacy at the international level that stresses upon crucial provisions among the said international agreements and non-binding initiatives can assist in preserving the continuity of indigenous people and local communities' astronomical knowledge for future generations to come so that this knowledge will not be obsolete and lost for good. All parties must do their part to address this menace to bring mega-constellation satellite companies into line. This study, which emphasises the importance of preserving the astronomical knowledge of Malay farmers and fishermen in Malaysia through the utilisation of international agreements, as well as astronomical and heritage initiatives within the FAO and UNESCO, not only supports heritage diplomacy but enriches the discipline of international relations as there is scant literature in this area. Moreover, this study also contributes to policymaking as it gives an idea to bureaucrats within the ministries of foreign policy, agriculture, heritage and science to approach the preservation of farmers' and fishermen's astronomical knowledge not in silos, but one which requires a multidisciplinary approach and cooperation among one another to address the said matter.

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