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WORKING PAPER

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Roles of Malaysian Indigenous Communities in Biodiversity Conservation: A Case Study Approach

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Abstract

This paper presents two case studies that underscore the importance of involving indigenous communities in biodiversity conservation efforts. The first case study demonstrates the criticality of acknowledging and integrating indigenous knowledge within scientific investigations pertaining to biodiversity conservation. Failing to recognize this valuable resource may result in missed opportunities for optimal preservation of biodiversity. The second case study highlights the importance of engaging indigenous communities in conserving a forest reserve through forest patrolling and monitoring alongside measures to curb illegal activities. This approach not only helps preserve biodiversity but also sustains the livelihoods of indigenous communities through the provision of monetary incentives. Furthermore, the active involvement of indigenous communities in ecotourism development allows for the integration of their traditional knowledge and practices, fostering effective management of ecotourism activities and safeguarding their territories against detrimental impacts. Moving forward, it is essential for governmental agencies and relevant authorities to identify effective strategies to promote the active involvement of indigenous communities in biodiversity conservation.

Keywords: Indigenous communities, biodiversity conservation, indigenous knowledge and practices

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1. Introduction

Indigenous communities are key stewards of nature and biodiversity. Despite a meager five percent of the population worldwide, the indigenous communities oversee or hold tenure over one-quarter of the global land surface, especially land cover that provides refuge and support for 80% of the global biodiversity (Garnett et al., 2018).

Malaysia, one of the world's megadiverse countries, has over four million indigenous people, accounting for approximately 14% of its population (Convention on Biological Diversity, 2022; International Work Group for Indigenous Affairs, 2022). Malaysia is categorized into West Peninsular Malaysia and East Malaysia: West Malaysia comprises 11 states, whereas East Malaysia consists of two states, Sabah and Sarawak, which are also collectively known as the Malaysian Borneo (Gimbad, 2020). Collectively, these states have over 80 indigenous ethnic subgroups, including Kensai, Jahai, Mendriq, Cheq Wong, Temair, Iban, Bidayuh, and Dusun, just to name a few (International Work Group for Indigenous Affairs, 2022; Minority Rights Group International, 2018).

This paper utilizes the case study approach to highlight the contributions of Indigenous communities in Malaysia to biodiversity conservation. In particular, two case studies are presented. The first case study discusses a recent finding on the misclassification of tree species by Western taxonomy, knowledge which has long been known by the Iban and Dusun communities. For a broader perspective of the conservatory roles of indigenous communities, the second case study showcases the conservation roles of the Jahai and Temair people in the Belum-Temengor Rainforest, Perak. In particular, this case study highlights some of the challenges faced by the indigenous communities in the rainforest and their roles in biodiversity conservation. Following the detailed elaboration of the case studies, the paper discusses several

important lessons from the case studies and provides a few suggestions based on the lessons identified.

2. Case Study A: Iban and Dusun: Accurate Identification of Bornean Tree Species

The Iban and Dusun communities are indigenous people concentrated in Sarawak and Sabah, respectively (Simonson et al., 2011). The Iban community, also known as Sea Dayaks, is the largest ethnic group in Sarawak (Kreier, 2022; Simonson et al., 2011). It accounts for 30% of Sarawak's 2.6 million population (i.e., 780,000 people) (Minority Rights Group International, 2018). Similarly, the Dusun community is part of the largest indigenous group in Sabah, known as the Kadazandusun, which constitutes approximately one-quarter of the state's 3.8 million population (i.e., 950,000 people) (Gimbad, 2020; Statista, 2021). These indigenous tribes have long histories with the lands they reside on. The settlement of the Iban community in Sarawak dates back to the 1600s, while the Dusun people have been living in Sabah since the 1500s (British North Borneo Herald, 2021; Utusan Sarawak, 2022). With long histories of direct interaction with the natural environment, indigenous communities have built deep understanding and broad knowledge of the local natural ecosystem (Sneed, 2019). The natural ecosystem is the main source of essential resources for the indigenous communities, including food, medicine, and shelter. To navigate and adapt to nature, indigenous communities have developed localized knowledge systems to inform fundamental daily decisions, such as which food is safe or nutritious to consume (Mongabay, 2020; UNESCO, 2021).

Indigenous people in tropical regions have developed extensive knowledge about plants and their services due to centuries of interactions with a wide range of plant species (Camara-Leret, 2019). Known as one of the global biodiversity hotspots, Borneo consists of over 15,000 plant species, many of which are endemic to the region (WWF, 2020). In particular, Iban

Lumok and Pingan are two endemic plant species in Malaysian Borneo, which are the equivalent to Timadang and Tonggom-Onggom to the Dusun people in Sabah. These trees are endemic to the lowland rainforests in Borneo, and bear fruits that are described as "juicy", "sweet", and "superior to jackfruits" (Garner et al., 2022; Plants for A Future, 2022, para. 1). Lumok and Pingan are differentiated by several distinct features, including the leaf, fruit, and twig sizes, as well as fruit sweetness. Lumok has larger leaves, as well as bigger, sweeter fruits, as compared to Pingan, which has tinier leaves, smaller and less-sweet fruits (Garner et al., 2022). While Lumok and Pinggan are identified as separate taxa by the Iban and Dusun communities, they are classified under a single species in the Linnaean taxonomy as the *Artocarpus odaratissimus* (Cowan, 2022; Garner et al., 2022).

After almost two centuries of discrepancy on this subject, a recent study by Garner and colleagues (2022) has confirmed that the Iban Lumok and Pingan – or the Dusun Timadang and Tonggom-Onggom – are indeed two different species. After observing that Iban field botanists were referring to the trees using two different names, Garner and colleagues (2022) decided to investigate this issue (Krier, 2022). To accurately identify the correct taxonomy, the researchers extracted DNA samples from the aforementioned trees in Malaysian Borneo, as well as obtained samples from herbarium specimens of the whole species range. Through the phylogenetic analyses and DNA microsatellite sequencing, Iban Lumok was indeed found to be genetically different from Pinggan. While these two species are closely related, the degree of their genetic and morphological distinctness is vast enough that they should be identified as separate taxonomies (Garner et al., 2022).

This case study showcases an example whereby long-standing knowledge of the Linnaean taxonomy was found to be less accurate than the indigenous classification of trees drawn from Iban's and Dusun's knowledge. With this new finding, the risks of extinction for

these trees may be significantly decreased. This is because scientific nomenclature forms the basis of species conservation; hence only taxa with official names are actively evaluated and safeguarded (Gardner et al., 2022). In all, this case example highlights the significance of indigenous knowledge developed through generations of societies on the land, and the failure to appreciate and engage with indigenous knowledge may result in the loss of opportunities to achieve better biodiversity conservation outcomes.

3. Case Study B: Jahai and Temiar: Conservation of the Belum-Temengor Rainforest

Covering an area of about 290,000 hectares in Perak, Malaysia, the Belum-Temengor Rainforest is one of the largest rainforests in the world. Moreover, it has existed for more than 130,000 million years, making it one of the world's oldest rainforests (Belum Temenggor, 2021). The forest is separated into two main zones: The Royal Belum State Park, which consists of 117,500 hectares of forest, and the Temenggor Forest Reserve, where the Temenggor Lake is situated (Belum Temenggor, 2021). Remarkably, the rainforest is home to a substantial amount of flora and fauna endemic to the region, including ten species of hornbills and 80 species of mammals (UNESCO, 2017). It also houses a number of threatened plant species, such as *Cleissostoma complicatum and Dipterocarpus costatus, as well as endangered animal species, such as the Asian* elephant (*Elephas maximus maximus*), Malayan Sun Bear (*Helarctos malayanus*), and the iconic Malayan tiger (*Panthera tigris jacksoni*). Besides that, four species of the world's largest flower – *Rafflesia – can also be found in the rainforest.* Due to its rich biodiversity, the Royal Belum State Park was gazetted as a terrestrial protected area in 2007 (UNESCO, 2017). In addition to the species richness, the Belum-Temengor Rainforest also shelters two main groups of indigenous people, namely the Jahais and Temiar, who rely heavily on the rainforest's natural resources for their livelihoods (Fadzil et al., 2013). Specifically, the

Jahais reside in the northern region of the forest, whereas the Temiar tribe inhabits the southern area of the forest (Belum Rainforest Resort, 2022). These indigenous communities generally live by hunting, fishing, harvesting plants, and collecting honey and other non-timber forest products from the forest. Importantly, they also play a significant role in protecting and conserving biodiversity in the Belum-Temengor Rainforest (Belum Temenggor, 2021). However, high levels of human footprint in the forest reserve have substantially threatened biodiversity and also the livelihood of indigenous communities residing in the region (Abdullah et al., 2013). Detailed insights into the challenges faced by the indigenous communities in the forest reserve and their roles in biodiversity conservation are discussed in the sections that follow.

3.1 Challenges Faced by the Indigenous Communities in the Royal Belum Forest Reserve

As mentioned above, the Royal Belum Forest Reserve is home to two main indigenous communities: the Jahais and Temiar, who have been residing in the forest for decades (Loke et al., 2020). The Jahai tribe primarily lives along Sungai Tiang and Sungai Kejar, whereas the Temiar tribe mainly lives in the southern region of the forest reserve (Perak State Parks Corporation, 2016).

Even though the Royal Belum State Park was set up to protect nature, as a tourist attraction, it has somewhat brought about unsustainable tourism development, posing threats to the indigenous communities in the forest reserve (Abdullah et al., 2013). A number of communities were forced to leave their settlements due to the development of tourist sites (Kamarudin, 2015). Moreover, some of their settlements and villages were designated as part of tourist hotspots, which brought about trouble for the local communities (Abdullah et al., 2013). For instance, visitors and tourists often offer tokens of money and donations to the

indigenous communities, indirectly promoting the culture of begging among them (Abdullah et al., 2013). Also, the development of ecotourism in the Royal Belum Forest Reserve failed to bring substantial benefits to the indigenous communities. This is because a majority of the indigenous communities are not involved in ecotourism activities due to their low levels of education; they are still primarily hunters and collectors of non-timber forest products (Abdullah et al., 2013). This demonstrates that ecotourism at the forest reserve does not contribute much to the economic development of indigenous communities.

Other than the above, the continuation of poaching activities has negatively impacted the indigenous community through reduced food sources like animals and plants (Abdullah et al., 2013). This issue has persisted due to understaffing in managing and patrolling the forest reserve. In fact, only two rangers have been put in charge of patrolling the entire forest, resulting in ineffective detection of poachers and illegal loggers (Abdullah et al., 2013). Indeed, more than 400 animals were illegally hunted in Royal Belum Forest Reserve during 2009 – 2011, including certain threatened species, such as the Asian elephant, pangolin, Malayan tiger, and Sumatran rhinoceros (Abdullah et al., 2011). In addition to poaching, the agarwood trees in the forest reserve have been illegally harvested for economic gain (Lim & Noorainie, 2010). As a result, the indigenous communities in the forest reserve have been left with insufficient natural resources to sustain their livelihoods. Other than that, over-fishing and sport fishing at Temenggor Lake have polluted the water and threatened the fishery sources, further diminishing the food sources of the indigenous communities (Abdullah et al., 2011). The invasion of Escherichia coli (E. coli) bacteria and the discharge of untreated sewage from nearby hotels and tourist attractions have also threatened the aquatic ecosystem in Temenggor Lake. These issues have caused severe water pollution and food poisoning in the indigenous communities, who often consume water from rivers and lakes without filtration (Abdullah et

al., 2013). As can be seen, from these examples, indigenous communities face numerous challenges in the Royal Belum Forest Reserve.

3.2 Contributions of the Indigenous Communities in the Royal Belum Forest Reserve

Despite challenges, the indigenous community still plays a significant role in conserving biodiversity and protecting ecosystem vitality in the Royal Belum Forest Reserve (Yayasan Sime Darby, 2022). For example, local and traditional knowledge is essential in preserving the forest reserve. In fact, the Jahais and Temiar tribes believe that nature gods and spirits, such as Moyang Tapern dan Tok Samin, live in forests where supernatural powers exist in every object in the surrounding environment (Isa & Saidin, 2014). Hence, the overexploitation of natural resources is prohibited among the tribes (Likin et al., 2018). For instance, big trees in the forest are not allowed to be cut down, and only mature plants can be harvested (Likin et al., 2018). Moreover, they are not allowed to hunt and kill animals for purposes other than consumption. This is because they believe that the overexploitation of natural resources will eventually result in undesirable consequences (Yayasan Sime Darby, 2022). In fact, slaughtering and consuming certain species can create bad karma and bring about diseases. For example, among the Temiar and Jahai tribes, elephants and tigers are considered taboo animals that should not be hunted for food (Benjamin, 2014; Loke et al., 2020). As can be seen, the indigenous communities value reciprocity between humans and nature instead of perceiving nature as existing mainly for human benefit (Irvine et al., 2019; Sneed, 2019). Collectively, these beliefs and values translate into a multitude of spiritual beliefs, taboos, and traditions linked to practices or measures that may aid in preserving biodiversity, such as restrictions against over-harvesting or measures that disturb the ecological balance of forests.

As mentioned in the "challenges" section, poaching activities and illegal logging are some of the threats to the Royal Belum Forest Reserve. However, in recent years, the Perak State Park Corporation established the Menraq Patrol Unit, which includes the Jahai community and other NGOs, such as the Rimau, to collectively protect the forest from poaching, illegal hunting, and wildlife trafficking activities (Hussein, 2021). Specifically, the Jahai people, who are capable and literate, were recruited for forest-patrolling activities and were paid RM85 per day as incentives (Pearl, 2021). The formation of the Menraq Patrol Unit has allowed the Jahai indigenous community to earn at least RM2000 monthly income, contributing to their livelihoods. One of their job tasks is to help gather data related to poaching activities and wildlife information. In addition, they also actively encourage the local communities to get involved in biodiversity conservation efforts (Yayasan Sime Darby, 2022). Consequently, there has been a 90% reduction in poaching activities in the forest through joint efforts (Pearl, 2021). Four Malayan tiger cubs were recently spotted in the Royal Belum Forest Reserve. This clearly shows that the anti-poaching efforts by the Menraq Patrol Unit successfully saved the Malayan tigers from extinction (Milad, 2022).

In general, indigenous communities play important roles in safeguarding flora and fauna against illegal hunting, wildlife trade, and logging activities. They often work with law enforcement agencies or establish patrol programs to monitor the forests (Wilson-Holt, 2021). A study shows that indigenous communities are better able to guard the protected areas than rangers hired from external sources due to their knowledge and familiarity with the landscape of the entire forest (Williamson et al., 2020). Hence, indigenous communities often detect and report crimes or other illegal activities in the protected areas faster and more efficiently as compared to externally-hired patrol rangers (Hai et al., 2021; Williamson et al., 2020). In addition, a study shows that forests guarded by indigenous communities have a lower

deforestation rate compared to those that are not monitored and protected by indigenous communities (Porter-Bolland et al., 2012). Essentially, involving indigenous people in patrolling the forest has helped conserve biodiversity and contribute to their livelihoods. As such, policymakers and relevant authorities need to identify ways to improve the indigenous communities' participation rate in forest patrolling and monitoring, which are discussed in the following section.

4. Way Forward

4.1 Increase Recognition and Engagement of Indigenous Knowledge

The case study of the Iban and Dusun communities showcased an example where an important finding may not have been discovered without considering or engaging with indigenous taxonomy, underscoring the significance of indigenous knowledge even when molecular phylogenetics gains ultimate precedence in modern taxonomic classifications. Historically, there has been a hierarchy between Western "scientific" knowledge and indigenous knowledge, whereby the former is often framed as more valuable than the latter (Zurba & Papadopoulos, 2021). Moving forward, it is crucial for the fundamental acknowledgment and recognition of indigenous knowledge value to be present, even when the knowledge contradicts current scientific thought.

Recent years have seen a global increase in the incorporation of indigenous knowledge into scholarly and applied research (e.g., Jessen et al., 2021; Knopp et al., 2020; Wilder et al., 2016). In fact, the integration of indigenous knowledge in scientific research has increased from 5 studies in 1990 to over 1400 studies in 2018 (Jessen et al., 2021). For example, a study by Adom and colleagues (2016) utilized the qualitative approach to analyze the impacts of the Asante indigenous knowledge on conservation issues in Abono, a village in Ghana.

Specifically, the study revealed that the Asante indigenous knowledge systems, which include cultural taboos, folklore, proverbs, and cosmological beliefs, have been used to safeguard the areas in Ghana, especially those with rich biodiversity. While indigenous knowledge is increasingly explored and applied in research, the integration of Malaysian indigenous knowledge in scientific research still has significant room for improvement (Halim et al., 2012). This should be addressed by the government and research institutions since the lack of effective engagement has led to a loss of opportunities to achieve better biodiversity conservation outcomes.

4.2 Encourage Indigenous Communities to Actively Participate in Forest Patrolling and Monitoring

Based on the Royal Belum case study, it is clear that indigenous communities play important roles in patrolling and monitoring protected areas. Poaching activities in the Royal Belum Forest Reserve were drastically reduced under the patrol and monitoring of the Menraq Patrol Unit, which involves the indigenous communities (Pearl, 2021). As such, the support and involvement of the indigenous communities in forest patrolling appear to be essential in protecting the protected areas from various illegal encounters (Wiafe, 2016). As shown in the case study, the Jahai community could earn a monthly income of RM2000 through the Menraq Patrol Unit, hence attracting the indigenous community to actively participate in the patrolling activities (Yayasan Sime Darby, 2022). Besides earning extra income, indigenous communities were able to protect their ancestral lands, which they heavily rely on for their livelihoods. Past studies have similarly shown that indigenous communities are motivated mainly by the benefits and incentives they can gain by participating in forest protection and management activities (Derkyi et al., 2021; Kacho et al., 2014; Musyoki et al., 2016). As can be seen, rewarding incentive packages are essential in promoting the indigenous communities' participation in

forest patrolling and monitoring. Moving forward, policymakers, local authorities, or conservationists should offer sufficient monetary incentives to motivate indigenous communities to actively participate in forest patrolling and monitoring so that their livelihoods are well taken care of (Slough et al., 2021; Truong, 2022).

Additionally, to support and further encourage the indigenous communities to participate in forest patrolling and monitoring, the government bodies and relevant conservationists should establish training programs for indigenous communities so that they can be more confident and adept at performing their patrolling tasks (Global Forest Watch, 2021; Williamson et al., 2020). Patrolling knowledge such as keeping track of records, managing budgets for forest patrolling activities, using Smartphones and drones to detect illegal activities, Geographic Positioning Systems (GPS), and map resources are important to ensure the success of forest patrol and monitoring (Williamson et al., 2020). Indigenous patrollers should also be well-trained with the Spatial Monitoring and Reporting Tool (SMART) patrolling system. Essentially, the SMART system allows them to utilize GPS systems to collect more systematic data in the forests, optimally allocate patrolling resources to safeguard the forests against illegal activities (e.g., illegal hunting and logging), and facilitate the protection of forests in an efficient way (WWF-Malaysia, 2014). In fact, research has suggested that accessibility to forestry training programs can influence indigenous communities' level of participation in forest patrolling activities (Derkyi et al., 2021). This can be attributed to the fact that the training programs enable them to become more mindful of the detrimental consequences of illegal activities in the forests, which can enhance their motivation to protect and monitor their homeland (Derkyi et al., 2021). In all, with monetary incentives and patrolling training activities, indigenous communities are likely

to be more motivated to participate in forest patrolling and monitoring, contributing to biodiversity conservation in the forest reserve.

4.3 Minimize the Negative Impacts of Ecotourism on the Forest Reserve and the Indigenous Communities

As highlighted in the Belum-Temenggor case study, ecotourism has posed severe threats to the forest reserve and indigenous communities in the area. For example, untreated sewage from the Royal Belum tourist attractions has contaminated rivers and lakes, which the indigenous communities rely on for water and food sources (Abdullah et al., 2013). Moreover, sport fishing activities (part of the ecotourism activities) at Temenggor Lake have posed threats to the fishery sources of the indigenous communities (Abdullah et al., 2011). Moving forward, one way to minimize the negative impacts of ecotourism on the forest reserve is to promote responsible tourism, which emphasizes the development of environmentally based and sustainable tourism activities, the involvement of local communities in the tourism industry, and the prevention of over-exploitation and over-consumption (Chan et al., 2021). Indigenous communities are key stakeholders of the forest reserve where ecotourism takes place; hence, by involving them as community representatives on the ecotourism board, they are more likely to share their indigenous knowledge and traditional practices, which are essential in preserving and protecting the forest from the negative impacts of ecotourism. In other words, the indigenous communities can integrate their indigenous knowledge and cultural norms into managing and planning ecotourism activities, which may help alleviate pollution, over-exploitation, and over-consumption of natural resources in the forests (Nagarjuna, 2015; Prasetyo, 2020). In essence, involving them in the planning and decision-making processes of ecotourism development is likely to lead to a more sustainable ecotourism development,

which also helps to preserve their indigenous culture and improve their quality of life (Chan et al., 2021; Nagarjuna, 2015). As such, government agencies and tour operators should identify ways to actively engage them in the development of ecotourism. For example, tour operators need to collaborate with government agencies to deliver workshops on the benefits of involving indigenous communities in ecotourism development. Other than that, the indigenous communities should also be trained to become professional tourist guides in order to promote their cultural knowledge and heritage in the forest reserve. This approach enables the preservation of the uniqueness of their cultural heritage. Most importantly, it is essential to provide training sessions related to ecotourism development to the indigenous communities so that they are well-equipped with the relevant knowledge and skills needed to efficiently plan, manage, and monitor ecotourism development (Kamarudin et al., 2015). The approaches mentioned above are more likely to increase the indigenous communities' participation in ecotourism development when they are aware that these activities can provide economic benefits and improve their welfare whilst simultaneously promoting and preserving their cultural heritage in a sustainable manner (Chan et al., 2021).

Another issue associated with ecotourism at the Royal Belum Forest Reserve is that it has promoted the culture of begging among indigenous communities rather than providing them with employment opportunities (Abdullah et al., 2013). In fact, a majority of the indigenous communities remain hunters and gatherers of forest resources. This is because most of the indigenous communities in the Belum-Temenggor forest reserve have low levels of educational achievement, impeding them from getting jobs in the ecotourism industry (Abdullah et al., 2013; Rasoolimanesh et al., 2017). In general, the lack of equality and access to education has worsened poverty and unemployment issues among

indigenous communities (Sawalludin et al., 2020). The low educational achievement issue is primarily due to the fact that most of the indigenous communities' settlements are located very far away from the schools in town. Poor transportation connectivity in rural areas also serves as one of the barriers that demotivated indigenous children from traveling to schools for education (Sawalludin et al., 2020). In addition, the lack of awareness among parents on the importance of education is another main reason for low levels of educational achievement among the indigenous communities (Sawalludin et al., 2020). Moving forward, government bodies and relevant authorities should hold educational awareness campaigns near settlements to share and discuss the importance of education with the indigenous communities, thereby encouraging indigenous parents to send their children to schools. Other than that, NGOs or social enterprises should also set up schools nearby the indigenous communities' settlements to ensure that every indigenous child has easy access to proper education. To address the transport connectivity issue, government agencies, private sector companies, and other NGOs must collaborate to build better roads and bridges to shorten travel time from the indigenous communities' settlements to schools. Doing so is likely to enhance the indigenous children's enthusiasm to go to school and improve their employment opportunities in the ecotourism industry in the future, which then helps in poverty alleviation among the indigenous communities.

5. Conclusion

In summary, the two case studies above showcased the importance of involving indigenous communities in biodiversity conservation efforts. One of the key takeaways from the case studies is that it is crucial to acknowledge and integrate indigenous knowledge in scientific research relevant to biodiversity conservation. The failure to engage with indigenous knowledge may risk losing opportunities to achieve better biodiversity conservation

outcomes. In addition to restricting illegal activities in forest reserves, involving indigenous communities in forest patrolling and monitoring also helps contribute to their livelihoods, particularly through the provision of monetary incentives. Furthermore, it is also vital to engage indigenous communities in ecotourism development so that they can integrate their traditional knowledge and practices in managing ecotourism activities, which aids in protecting their territories from the negative impacts of ecotourism. Moving forward, government agencies and relevant authorities should identify effective ways to promote the active participation of indigenous communities in biodiversity conservation, which also improves their living standards through benefits and incentives offered in return for their efforts.

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Based on a more inclusive and holistic consideration, Sunway IGSC identifies three primary pillars of competitiveness: Economic, Social, and Environment. The three pillars of competitiveness provide direction and focus to the type of questions asked and the work conducted within IGSC:

- **Economic health -** This pillar investigates drivers of competitiveness from the vantage point of firms, industry, and national ecosystems, with a particular focus on policies and drivers of structure and competitive strategies to create positions of sustainable advantage.
- **Social health -** This pillar focuses on issues of distribution of wealth, equity, and unity within ecosystems as a consequence of economic policies and strategies at the firm, industry, and national levels. The lens scrutinizes who creates value, for whom, and how is this value distributed among the diverse stakeholders operating within the ecosystem. It stresses the need for inclusive creation and sharing of value creation to ensure shared prosperity.
- **Environment health -** This pillar scrutinizes how actions of individuals, firms, industry, and government impact the environment and draws into explicit consideration the need to go beyond the simple mantra of firm profit maximization and short-run economic development and competitiveness by holistic consideration of the costs to the natural environment and life of species, including that of the human race over the long run.

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