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Malaysia's greatest environmental problem is the lack of proper enforcement of existing environmental laws and regulations. This failure to enforce stems from an array of issues, including lack of trained personnel, lack of public support for addressing environmental issues, and a profit-first economic mentality that promotes business success over environmental regulation. This article compares two case studies on the palm oil and bauxite mining industries to evaluate the regulatory processes in place while providing an outlook on the future of Malaysia's natural environment.

Introduction

Malaysia's greatest environmental problem is the lack of proper enforcement of existing environmental laws and regulations. This failure to enforce stems from an array of issues, including lack of trained personnel and transportation, lack of public support for addressing environmental issues due to minimal environmental awareness, and a profit-first economic mentality that promotes business success over environmental regulation. There is, however, hope for the natural environment in Malaysia demonstrated by recent political events. From 1957 to 2018, the Barisan Nasional political coalition ruled Malaysia, and, for the last 9 years of the period, Najib Razak held the position of Prime Minister (PM). In light of this history, the result of Malaysia's 2018 general election, in which 92-year-old Mahathir Mohamad of the opposing coalition (Pakatan Harapan) and a past mentor of Najib became Malaysia's new PM, was extraordinary. Najib's rule was clouded by accusations of corruption and greed, which finally ended in his arrest by the Malaysian Anti-Corruption Commission in 2018 (Ramzy). PM Mahathir's election reflects a sense of hope and pride: his administration demonstrates greater awareness of environmental issues in Malaysia, given the ensuing discussions on sustainable palm oil practice and preserving all current forested land (Chin).

Since the early 1970s, the Malaysian government has addressed environmental issues by passing serious legislative improvements. The establishment of Malaysia's Ministry of Science, Technology and Innovation in 1973 (now the Ministry of Energy, Science, Technology, Environment and Climate Change [MESTECC]) indicated Malaysia's commitment to research and development in science and technology for a sustainable future. Environmental legislation, including the Environmental Quality Act 1974, indicated Malaysia's ability to prioritize environmental

initiatives. Since the 1990s, however, Malaysia has done little to reinforce and modernize environmental regulation efforts due to the government's strong emphasis on economic development. The Malaysian government must introduce further successful environmental initiatives in order to assume full responsibility for its environmental footprint. To that end, Yeo Bee Yin, the newly appointed Minister of MESTECC, is a particularly promising environmental advocate.

Unfortunately, the environment was not identified as one of the ten core sectors to be immediately addressed by PM Mahathir's administration; therefore, Yeo's Ministry faces an uphill battle (Siew). To highlight Malaysia's lackluster environmental regulatory and enforcement measures, I focus on the cases of palm oil plantations and bauxite mining operations, which both have large-scale environmental implications for Malaysia. Before examining these two cases, I discuss existing legislation as well as supporting government institutions. Palm oil is exemplifying because Malaysia produces 39% of the global palm oil supply, which translates to a sprawling network of plantations throughout the countryside ("One of…"). Bauxite mining, likewise, is representative of mismanaged environmental impacts, leading to a 2016 temporary ban. Both industries, if left unregulated, will lead to environmental degradation through processes, such as deforestation, runoff, and particulates in air. By way of conclusion, I end with comparisons between the two case studies and a few hopeful initiatives for the future.

The Environment in Malaysia

Malaysia is on the cusp of being classified by the World Bank as a high-income country capable of competing in the international market. Malaysia's three main market exports—electronics, high-grade petroleum, and palm oil—are a strong foundation for a promising economic future. Malaysia's policies that supported economic development prior to 2018, however, left the natural environment in jeopardy. The disposal of e-waste, extraction of petroleum, production of palm oil, and mining of bauxite all pose serious environmental threats. To counter such threats, newly elected PM Mahathir has articulated clear concern for environmentally sustainable economic development (Mahathir).

Environmental degradation is particularly problematic because, according to the National Biodiversity Index, Malaysia is ranked as high as twelfth in the world for its biodiversity (Shanmugaraj). Malaysia is home to more than 15,000 vascular plants and 152,000 animal species. Furthermore, Malaysia hosts about 1,140 species listed on the International Union for Conservation of Nature Red List, which identifies endangered species, such as the Malayan tiger, the Borneo pygmy elephant, and the orangutan ("Malaysia—Country Profile"). In addition to animal and plant life, peat soil is abundant in Malaysia. Peat acts as a carbon sink, storing carbon dioxide from the atmosphere. The continuous expansion of palm plantations in Malaysia has resulted in the destruction of many peat deposits. A report by the Union of Concerned Scientists worryingly claims the peat soils in Southeast Asia contain carbon levels comparable to the amount stored in vegetation in the Amazon forest, which means continued deforestation on peat soil will have negative impacts on climate change ("Palm Oil and...").

In Malaysia, remediating environmental degradation incidents is theoretically the responsibility of the federal government, specifically the Ministry of Water, Land and Natural Resources and the Department of Environment (DOE) within the MESTECC. Ideally, Malaysian government inspectors monitor and track data on emissions and contaminant concentrations in air, soil, and water at the site of industrial and agricultural land use areas. In reality, Malaysia's federal government does not have an adequate number of trained personnel to carry out these inspections (Academy…). Since the early 2000s, in an attempt to address the federal government's lack of environmental regulatory resources, most enforcement has become the responsibility of individual states.

To reiterate, Malaysia's environmental issues are not due to a lack of regulatory legislation. The difficulty is that legislation has been diluted by weak implementation and

underfunded ministries ("Palm Oil Risk…"). Notably, the government passed the National Land Code 1966, Protection of Wildlife Act 1972, Environmental Quality Act 1974, National Parks Act 1980, National Forestry Act 1984, Fisheries Act 1985, and Environmental Quality Order 1989. The most relevant, the Environmental Quality Act, established the Environmental Quality Council with a Director General who may grant prescribed activity licenses to businesses. The act also defines what constitutes soil and water pollution as well as details the cases in which environmental impact assessments (EIAs) are required. The Environmental Quality Order clarifies vague terminology in the previous 1974 act in addition to expanding on the types of proscribed illegal activities (Mohammad). The National Land Code gives the states the power to approve mining activities by issuing permits and similarly approves permits for agricultural land use ("National Land…"). Malaysia has also committed to several international agreements focused on the environment. For instance, Malaysia promises to reduce carbon emissions by 2030 through the United Nations Paris Agreement and is a member of the Convention on Biological Diversity.

License and permit acquisition by commercial entities is an essential aspect related to environmental regulation. Figure 1 depicts the administrative process necessary to obtain licensing and permission to conduct prescribed activities and lists the formal documentation that needs approval by the Director General of Environmental Quality before a project can begin. Additionally, for palm oil plantations, license approval requires personal identification, company registration, land registration, and an EIA if land area exceeds 500 hectares. Approval for oil palm mills requires the same documentation and additional proof of capital of about RM5 million ($1,200,000) ("Criteria and Guidelines…). Bauxite mining operation approval was a much more lenient process with respect to required documentation, which later contributed to the 2016 temporary ban.

The Environmental Quality Order 1987 specifies which activities require EIA approval. Examples of these activities include agricultural development greater than 500 hectares, mining minerals on plots greater than 250 hectares, and constructing waste treatment facilities. In the case of bauxite mining, an EIA usually is not required due to the limited or small land area involved. EIAs are conducted on a state level and then reported to the DOE (Memon). The penalty in Malaysia for mining without a valid license, according to the State Mineral Act, is a maximum fine of RM500,000 ($123,000) or at most 10 years in prison or both (Academy…). Given the smaller land areas used in mining, illegal mining activities are hard to discover and thus less likely to be penalized. Oil palm plantations operating without a proper license is highly unlikely to occur.

Palm oil plantations and bauxite mining are two distinct cases for examining Malaysia's enforcement problem. Palm oil plantations have caused mass deforestation, while bauxite mining runoff releases high heavy metal concentrations into local rivers and streams. The following section outlines the environmental impact of these two commodities and the challenges Malaysia's federal government must overcome to prepare for a sustainable future.

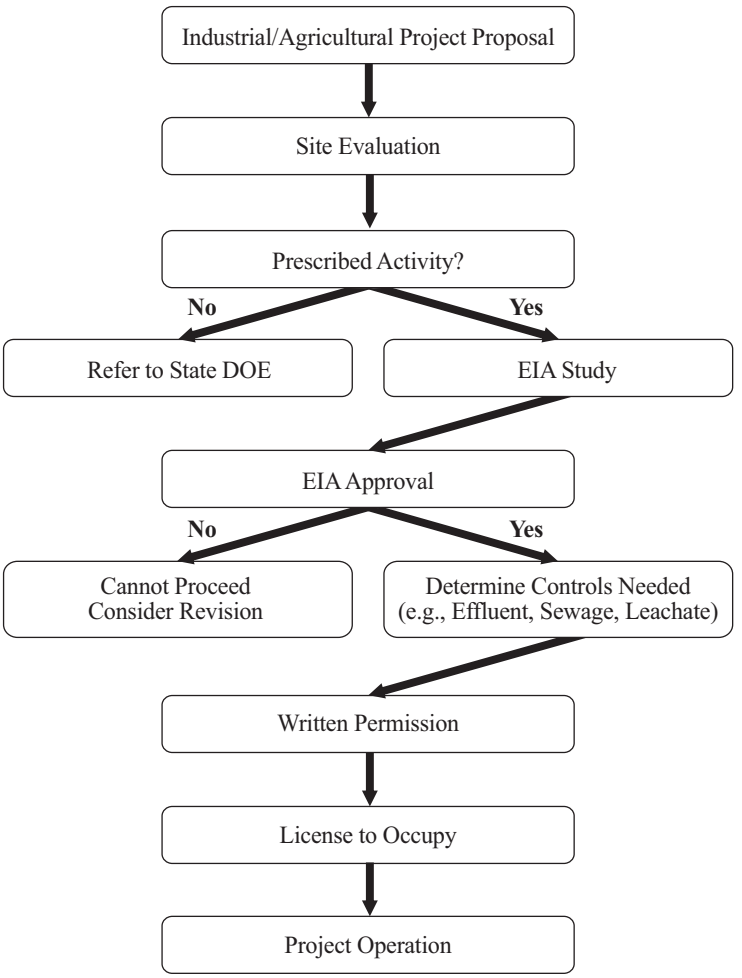
Case Studies

Palm Oil

Palm oil serves as a versatile market good that can be used for a wide array of products (biofuels, detergent, shampoo, etc.). The British introduced the African oil palm to Malaysia in the 1870s, but its commercial use was not fully recognized until the early 1900s ("The African Oil…"). Since then, oil palm has become a fundamental part of the economy. Malaysia is the second largest palm oil producer worldwide, producing 39% of the global supply ("One of…"). Pressure to switch to sustainable production practices to meet greater global consumer environmental awareness and expectations contributes to the concern over environmental regulation enforcement in Malaysia.

Palm plantations begin with the deforestation of tropical forest. Oil palms begin producing harvestable fruit within 3 years of planting and have a life span of about

Figure 1
Environmental Requirement Process



Source: Flow chart derived from *Environmental Requirements: A Guide for Investors.*

30 years. Palm fruit is harvested continuously throughout a year and produces about 4 tons of crude palm oil per hectare per year ("What Is Palm Oil?"). After the fruit bundles are collected, the fruit is steamed to soften the hard exterior and then pressed to release the oil stored in pore-like capsules. The resulting oil is brought to a refinery where it is degummed, bleached, filtered, deodorized, and packaged. The discussion of environmental degradation due to palm oil production is centered on deforestation and refinery emissions; as such, environmental inspectors are concerned predominantly with the first and last steps of the oil production process ("How It Works…"). Notwithstanding, the in-between steps, such as the use of agrochemicals, runoff, and monoculture practice, also are contributors to environmental degradation that can be addressed once routine inspections are established.

Prior to 2000, three institutions existed to address issues concerning palm oil within the DOE: (1) the Palm Oil Registration and Licensing Authority (PORLA), which performed quality control and licensing; (2)

the Palm Oil Research Institute of Malaysia (PORIM), which conducted research on palm oil extraction; and (3) the Malaysian Palm Oil Council (MPOC), which proposed Pesticide Act Rules and integrated pest management practices. In 2000, PORLA and PORIM merged to form the Malaysian Palm Oil Board (MPOB) to focus on developing palm oil policies and ensure a sustainable future for the industry. In addition to the current MPOC and MPOB, the DOE includes the Malaysia Oil Palm Growers Council (MOPGC), which gives industry leaders an opportunity to voice their concerns. The collaboration between MOPGC and MPOB has led to research on palm waste treatment and to national standards for acceptable levels of refinery solid and liquid waste.

Oil palm plantations are regulated by three main pieces of legislation: the National Land Code, the Forest Enactment, and the Environmental Quality Act. The National Land Code categorizes land types and outlines the federal and state level regulatory responsibilities and associated chain of command. The Forest Enactment encompasses the creation of forest reserves, forest management, and penalties associated with deforestation and indigenous land encroachment.

Driving through Malaysia's countryside reveals a sea of oil palm that is now a staple of the landscape. As of 2015, palm oil plantations occupied 5.64 million hectares, which is 17% of Malaysia's total land area. To help determine the environmental impact of the sprawling network of plantations, several studies have been conducted. In 2017, the environmental nongovernmental organization (NGO), Nature Economy and People Connected, conducted a risk assessment on palm oil plantations in the state of Sabah. The study revealed elevated risks for deforestation, encroachment on indigenous peoples, and lack of enforcement of regulations. The study also discovered that many permits for plantations had been forged by the Sabah government to give preferential treatment to private interests. This fraud has been confirmed by the numerous pending corruption cases in Sabah with respect to lenient license issuing ("Palm Oil Risk…").

In 2008, a study revealed 55% to 59% of existing plantations resulted in rainforest/old growth deforestation (Koh and Wilcove). Shortly after being sworn into office, Mahathir announced the halt of expansion of palm oil plantations to combat the rate of deforestation. The goal is to keep at least 50% of Malaysia's total land mass forested in order to protect biodiversity and peat soil deposits (as discussed previously). The plan to halt expansion has the potential to benefit Malaysia's economy because there is an excess of palm oil production globally due to Malaysian and Indonesian overproduction. By decreasing production, the price of palm oil should correspondingly rise. Furthermore, Minister of Primary Industries Teresa Kok plans to emphasize the need for palm oil producers to focus on first-class[1] palm oil production, which in turn will lead to higher profit levels (Chin).

The focus on first-class palm oil in combination with reduced output will help, but there are still a number of environment concerns to be addressed. Fortunately for environmental advocates, demand for Malaysia's palm oil will likely decrease due to the recent European Commission decision to eradicate the use of palm oil in biofuels by 2020 (Ellis-Petersen). The EU currently consumes palm oil as a biofuel, but consumers require the oil to be premium grade. Even in the United States, influential news outlets such as *The New York Times* have reported on the terrible impact palm oil has had through deforestation and large increases in carbon emissions after the United States required vegetable oil use in biofuel (Lustgarten). The debate on palm oil use in biofuel is centered around rampant deforestation caused by the continual global demand coupled with the uptick in global carbon emissions. Additionally, soil erosion and loss of endangered species habitat cause concern. Much of the deforested land consisted of tropical rainforest, which has had severe implications on biodiversity. Despite these ongoing concerns, there is some evidence that increased attention is being focused on solutions.

One of the more promising efforts is taking place in terms of sustainable palm oil production. As a founder of the Roundtable

[1]Palm oil is divided into classes based on fruit ripeness on arrival at the refinery.

of Sustainable Palm Oil (RSPO) sponsored by the World Wildlife Fund, Malaysia is a leader in this effort. The RSPO issues sustainable palm oil practice certifications ("Malaysian NGOs…"). Malaysian Sustainable Palm Oil is being implemented to increase the standards of palm oil production while incorporating conservation efforts with components such as a framework to conserve habitats for some of Malaysia's endangered species. In many ways, the sustainability campaign is a positive step toward green agricultural practice, but the plan still ignores the need to rehabilitate some forest land already lost. In other words, keeping 50% of Malaysia forested is critical, but similar pledges for revegetation could be made, for instance, to rehabilitate small plots on current palm oil plantations.

Bauxite Mining

Mining has been an active industry in Malaysia since the early 1800s. Bauxite, however, only recently became a prevalent commodity in Malaysia, capturing the attention of even small-scale miners in 2014 after Indonesia banned the exportation of bauxite ("Bauxite in…"). Indonesia's attempt to bolster its own aluminum industry allowed Malaysia to become China's primary bauxite supplier. Shortly after the spike in bauxite mining operations began, the enticing profit margins became clear. Early miners walked away with millions, but the farmers and local townspeople living near mining areas were forced to deal with the aftermath, even after the temporary 2016 ban on bauxite mining. Many farmers leased land to contractors for mining, hoping to earn quick profits. Now, these leased lands are a barren red landscape, a result of iron compounds, unusable until the excavated soil is replaced and fertilized.

Bauxite is mined near the ground surface, not in deep mines. Before mining can begin, a survey of the topsoil is conducted to plan for rehabilitation of the area after mining. Once the topsoil is removed, the cap rock is unearthed by excavators or broken down using explosives. This leaves the bauxite exposed so it can be loaded onto trucks and transported to a crusher. The finer material that passes through an initial sieve screen is crushed further to achieve a final size of 3 inches or less ("Bauxite Mining"). At the refinery, bauxite ore is dissolved with caustic soda, and the remaining alumina solution is put into precipitator tanks where the embedded aluminum hydroxide forms crystals as the solution cools. The crystals settle to the bottom of the tank. Finally, the resulting alumina is washed and heated to further remove impurities, resulting in a fine white powder. This refining process is termed the Bayer process ("Alumina Refining").

In Malaysia, the act of mining is controlled by the federal government, but land use is a state matter. Mining activities are governed by the Mineral Development Act 1994, which covers environmental protection steps for prescribed activities (effluent regulations, monitoring plans, and rehabilitation of mined areas after mine closure). No EIAs are required by the federal government because all bauxite mining operations cover less than 250 hectares of land; hence, bauxite mining is not considered a proscribed activity. The National Land Code incorporates activities involving the excavation and transportation of soil. Mining plans and environmental rehabilitation are not part of the land use requirements under the National Land Code. As a result, a loophole exists in the legislation because many mining operations are considered only under the National Land Code. Additionally, illegal mining exists on smaller plots of land (Academy…). Although bauxite mining is still a smaller newly organized industry, the adverse environmental impact of the mining cannot be ignored: the act of bauxite mining should be re-evaluated and incorporated into applicable legislation, regardless of total land use.

Bauxite rock is the world's main source for aluminum, and the process of mining the bauxite produces many unwanted side effects. Country roads become crowded with transport trucks while local homes, cars, and residents are covered in red dust. Runoff contaminates local water sources with high heavy metal concentrations. Concerns over high levels of mercury, arsenic, and other metals in the water supply make residents uneasy as reported increases in cancer rates, skin irritations, and asthma occur (Abdullah et al.). All these public health concerns culminated

in the 2016 temporary bauxite mining ban, which was employed to halt river and ocean water pollution and air pollution until proper regulations are in place (Moran). The Ministry of Natural Resources and Environment revoked the licenses of bauxite miners and enforces the temporary ban.

A 2017 case study by the Academy of Sciences Malaysia on bauxite mining found elevated risks in turbidity and suspended solid concentrations in local water systems, heavy metal concentrations in mining runoff, and wind-exposed stockpiles containing bauxite ore. Additionally, a 2018 risk assessment of bauxite mining published in the *Catena* science journal revealed elevated human risk due to air pollution from particulate matter. Results indicated increased cases of skin rashes and respiratory infections in residents located in proximity to bauxite mining operations (Kusin et al.). Both studies highlighted the failure of state and national government regulation enforcement due mainly to a lack of regulatory personnel and mining expertise. The risk assessment stated that for 200 mining sites, only 8 government officials were tasked with regulatory enforcement (Mohammad).

Malaysia seems set on postponing the reinstatement of bauxite mining until the environmental and human health impacts are fully understood, for example, through federally officiated EIAs. Currently, 20 mining companies await federal review of a proposed standard operating procedure for bauxite mining. The main concerns are the notable environmental impacts, such as mining residual leaching into the coastal waters and particulate matter air pollution. These consequences quickly evolve into loss in fisheries, decreased air quality and visibility, and deterioration of fertile soil. The procedure proposed, however, would insist that mining activities be strictly limited to predetermined locations away from the coast and that washing bays are implemented on site to reduce particulate release during mining and transport.

The profit-first mentality in Malaysia clearly drove the bauxite mining industry to maximize output by minimizing environmental concern. Fortunately, the negative human health impacts from bauxite mining were easily discerned even by unsuspecting locals. Public support for the ban was key to its implementation, but, as with palm oil plantations, the degradation of the surrounding natural environment also must be considered. A complete halt in operations is much easier to enforce than regulation of specific process stages, such as EIAs or licensing approval and site monitoring. The example of the ban on bauxite mining has been a success story for environmental protection in Malaysia, but it does not necessarily prove that environmental activism is more generally emphasized in government. As with regulating palm oil plantations, the lack of trained personnel able to create and then enforce environmental regulations at mining sites through routine inspections led to neglect of the natural environment.

Case Study Comparison

Palm oil and bauxite are two commodities that play major roles in Malaysia's economy and recent history. Palm oil is a significant contributor to exports, with oil palm plantations occupying a large land area. Bauxite mining, on the other hand, utilizes small plots of land and, due to the short time span of the industry's boom before the temporary ban, has had little impact on the economy. Given these aspects, bauxite mining and palm oil appear to be opposites. Scrutinizing palm oil and bauxite through the environmental impact lens, however, produces a very different image. Both result in significant environmental degradation, amplified by the government's lack of environmental regulation enforcement and profit-driven mentality. Oil palm plantations are responsible for significant deforestation in a country of great biodiversity, and unregulated bauxite mining operations result in human health impacts as well as air and water quality concerns.

Although still a significant industry, global palm oil demand is diminishing. As consumers become better informed regarding the ecological footprint of their products, they are more likely to buy environment-friendly items, income permitting. This trend is already becoming realized with the recent EU press releases on reducing palm oil use, but Malaysia's government appears confident

in maintaining production by reforming their approach. Malaysia has a strong base of government institutions supporting the local palm oil industry, which is recognized through recent pledges to maintain forest coverage and switch to sustainable oil palm plantation and refinery practices. These promises are key preliminary steps; however, until the federal government employs stringent enforcement strategies, degradation will continue to occur.

In contrast, the bauxite mining industry offers a great economic trade opportunity between Malaysia and China. As long as the government can address the temporary ban on bauxite and settle environmental regulation and enforcement measures for bauxite mining in a timely manner, Malaysia should be able to fill China's alumina supply void. Unlike palm oil, bauxite mining has much smaller representation in government institutions, and mining uses a smaller spatial scale. Environmental activism and lobbying will be critical in keeping the government accountable when the industry returns to full operation.

In coming years, Malaysia can reverse the lack of enforcement practices and continue to benefit economically from both industries but only with greater emphasis on environmental accountability. The fact that regulatory loopholes exist for both industries highlights the need for further reform. EIAs must be required for all mining activities, and the private interests of national and multinational corporations must be controlled by the federal government. As in many nations, NGOs are a vital part of environmental activism and provoking vital government intervention. Ideally, with Mahathir's administration, the federal government will begin to give voice to NGOs and other environmental interest groups in Malaysia and internationally.

A Hopeful Future

Minister Yeo from the MESTECC is a prime example of the leadership Malaysia needs to draw environmental well-being into key political discussions. Yeo leads numerous environmental reform initiatives and speaks publically about Malaysia's environmental issues, and she is putting greater emphasis on imposing penalties for the failure to meet Malaysia's environmental impact restrictions (" 'Buck Up…"). For instance, Yeo is deploying law enforcement in cases of illegal supposed plastic recycling factories that utilize empty plots of land as plastic landfills without permits. In 2018, Malaysia banned the import of plastic waste and closed 14 of these illegal recycling facilities (Chu). Another plan is to intensify the prosecution of open burning of trash and agricultural waste, including waste from palm oil plantations.

Malaysia's public awareness of environmental topics is key to holding the government accountable for environmental regulation. Citizens, prior to the implementation of environmental education in public schools in 1996, had little concern for the environment, and, since then, pro-environmental behavior has been minimal (Wong et al.). This attitude is discouraging given that Malaysia is among the top 12 mega-biodiversity[2] countries. Minister Yeo, however, believes that by reinforcing a strong focus on environmental activism in schools, young people will have greater passion for conservation and the environment and thus begin developing a sense of environmental responsibility. Domestic NGOs are already taking steps to address efforts in the palm and bauxite industries through the formation of the Malaysian Palm Oil NGO Coalition in 2013 and an NGO coalition against bauxite mining in 2015. Specifically, the Palm Oil NGO Coalition is focused on discussing pest management and pesticide use with industry titans as well as supporting community-based environmental activist groups largely composed of Malaysian indigenous people. The coalition against bauxite focuses on public awareness of bauxite mining pollution and is lobbying government to halt all exportation of bauxite in addition to the temporary ban. Both advocate groups are taking promising strides, but both also lack effective influence in ministry affairs.

Economic development and environmental protection are in opposition for most developing countries, and Malaysia is no exception. It is increasingly apparent that two of Yeo's biggest challenges will be determining when to lift

[2]Ranking of countries that are home to a plethora of diverse species, many being endemic.

the ban on bauxite mining and reallocating the necessary resources, namely experienced personnel, to provide Malaysia's DOE the means to enforce regulation. Hopefully, she will continue to put greater emphasis on enforcement and conservation with respect to palm oil production and bauxite mining practices and be receptive to environmental lobbyists who seek to push environmental initiatives to the forefront of government concern. While news reports regarding environmental protection efforts are encouraging and important to recognize, Mahathir's administration still has significant benchmarks to meet in order to shift political agendas toward addressing environmental issues and provide effective regulatory enforcement uniformly across Malaysia.

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