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RESEARCH BRIEF

Determination of Physical Geographical Components in the Construction of Environmental Sustainability Awareness Index of the Malaysian Society

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The Industrial Revolution 3.0 is about to come to an end and be replaced by the new industrial revolution, namely the Fourth Industrial Revolution (IR 4.0), which involves automation technology. This development presents new challenges to all sectors across the globe, in that they must adapt to the digital transformations involved, as a means of remaining competitive (World Economic Forum, 2016). In the IR 4.0 era, environmental sustainability should not be overlooked, given the impact of using the new technologies that are part and parcel of this revolution. This is because humans and the environment interact with each other in terms of the "effects" and "impacts" that make them interdependent. The importance of the environment to humanity is undeniable, as the environment is a source for residential development, a source for food, and human income (Arora, 2018). However, when one element of the environment changes, so do others. Thus, it can be seen that humans are agents of world transformation through unknowing "construction"; however, humans also destroy elements of the environment for the sake of economic or social gain. Therefore, various efforts have been made to preserve the environment—undertakings that, collectively, are known as sustainable development.

Sustainable development encompasses three key components: the environment, economic conditions, and social interests; this is an early idea with regard to sustainability (Brundtland Commission & Gro Harlem Brundtland, 1987). Sustainability is defined as the use of resources in a way that does not affect the environment or the well-being of humans living on earth, nor does it destroy the ability of future generations to meet their own needs adequately. In Malaysia, interest in and support for the concept of sustainable development began with the 2nd Malaysia Plan and continues up to today with Malaysia's commitment towards the Sustainable Development Goals (SDGs). The concept of sustainable development was first introduced at the World Conservation Strategy in 1980; its idea was updated in the World Commission on Environment and Development (WCED) in 1984. Finally, in 1987, the Brundtland Report was officially presented. This document emphasizes that sustainable development must be implemented by all countries in the face of current environmental issues (Weber, 2009). In a nutshell, the concept of sustainable development explains that the development undertaken to meet the needs of today's world population does not affect the needs of world populations of the future (WCED, 1987).

Sustainable development is also seen as one of the most proactive and practical modern development approaches to address issues between the demands

for development and environmental conservation (Fien, 1997; Hazura, 2009; Hopkins & McKeown, 2002; Huckle, 2009; Joshi, 2009; Moroye, 2005; Scoullos & Malotidi, 2004; Sterling, 2003). The world community is concerned about issues of environmental exploitation, economic development, and deteriorating quality of life (Omar, 2005). In fact, unplanned development activities and neglected environmental aspects also threaten the future of the next generations. It is undeniable that this condition is very serious and affects the survival, sustainability, and prosperity of civilization (Laily, 2009). An increase in the understanding and awareness of the environment are two important elements in building the country's capacity towards sustainable development (Yeoh, 2005). Environmental dimensions in the context of sustainable development serve as the basis for economic growth and social development. According to Herremans and Reid (2002), the environmental dimensions represent systems that maintain the integrity and maintenance of the ecosystem in relation to its continuous productivity and ecosystem functions. Nature offers a variety of ecosystem services to the city, such as clean air for a healthy environment, rivers that provide clean drinking water, and biodiversity that provides food, raw materials, medicines, and so on (Rosta, Lim & Fadhilah, 2011).

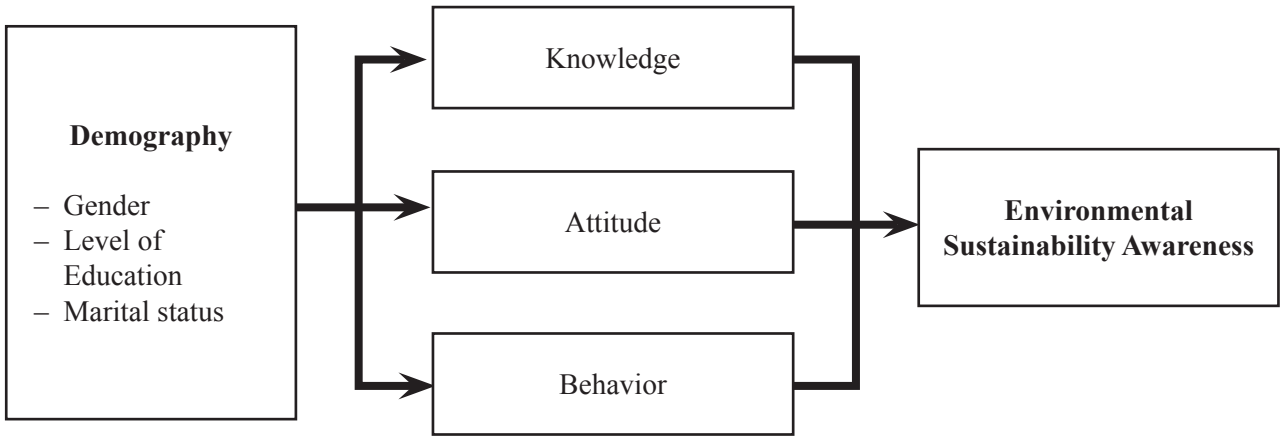
The environment, in terms of long-term sustainable development, consists of natural elements to be protected. For that reason, energy supply, transportation planning, industry, trade, and agriculture should be managed using a cycle of materials that is compatible with the natural cycle and fits with the natural environment (Rauch, 2002). In Malaysia, the Environmental Quality Act 1974 defines the environment as the physical factors of the environment, which include land, water, air, climate, sound, odor, taste, and biological factors of animals and plants, as well as the social aesthetic factors (Laws of Malaysia, 1974). Katiman (2002) stated that the environment naturally exists in a balanced state. No component in the environment destroys or threatens; instead, they benefit from each other. He also explained that a balanced environment comprises the components of diversified organisms, ecosystems, populations, colonization, and interdependence among organisms. Therefore, all five components of the environment need to be kept in balance so that the environment can continue to exist in a sustainable manner.

In summary, the system of sustainable environment needs to maintain the stability of basic resources, avoid exploitation of the system of renewable resources, and reduce the use of non-renewable resources. These include biodiversity maintenance, atmospheric stability, and ecosystem functioning that are not classified as economic resources. In the current study, the physical environment domain is referred to as the key element of awareness implemented based on the characteristics of sustainable development. Therefore, the purpose of this discussion is to help construct environmental measurement indicators, known as the environmental sustainability index in Malaysia, in preserving and conserving the environment to be appreciated by future generations.

Environmental Sustainability Awareness

Awareness is closely related to attitudes, behaviors, and perceptions that affect the mind or thinking (Allport, 1954). Barnhart and Thorndike (1962) defined awareness as impactful information of one's conscious awareness about issues and problems. This is based on observation, that is, awareness through the existence and critical stage of an issue and problem of a country and in general, the world, and is assessed through direct involvement of individuals regarding the issues and actions that need to be done by a person, society, country, or the world (Kalkan & Demirbas, 2017).

Environmental awareness is a term used to encompass environmental knowledge based on facts, attitudes, affectivity, and behaviors with respect to environmental issues, as well as values related to the environment (Arcury, Scollay & Johnson, 1987). There are several factors that can influence environmental awareness (positively or negatively): demographic factors; external factors like institutions, economy, social interactions, and cultures; and internal factors, such as motivation, knowledge, values, attitudes, emotions, locus of control, responsibility, and priorities. Previous theories introduced by Kohlberg (1958) as well as Kollmuss and Agyeman (2002), explaining the relationship between all factors and environmental awareness, are instead more focused on the knowledge that leads to behavioral change. In short, an environmental sustainability awareness model can be summarized, as shown in Figure 1.



Source: Kohlberg (1958) and Kollmuss and Agyeman (2002)

Figure 1. Environmental Sustainability Awareness Model

Awareness of the importance of conserving and preserving the environment is fundamental in changing people's living practices towards the implementation of environmental responsibility. However, the public's attitude towards environmental issues is so alarming that most people consider the role of environmental protection to be the responsibility of the government. People are more aware of environmental issues, especially those close to them; however, the awareness to become engaged in such issues is too minimal (Zurian & Norjan, 2003). Therefore, the occurrence of issues related to the environment is still a problem (even though it has long been debated) due to a minimization on the part of the populace of its import and impact. The need to build new elements must be continued to lead to changes in practices of making the environment a safer and healthier place to live.

Environmental Sustainability Index

Indexing is one of the common approaches used to measure behavior in economics and social science. For example, indices are used in quantitative studies, such as measuring stock price change (stock index) and measuring goods price change (consumer price index; Isa & Ahmad, 2015). Indices help data to be processed in a way that is easy to understand and accessible to users. Studies on environmental sustainability indices have been widely conducted globally. These include the Environmental Vulnerability Index (EVI), Environmental Quality Index (EQI), Environmental Performance Index (EPI), Environmental Sustainability Index (ESI), and Ecological Footprint (EF). The EF was formulated by Mathis Wackernagel and William Rees of the University of British Columbia in 1990. The EF is intended to measure the demand and supply of nature and track the use of six productivity categories: cropland, grazing land, fishing grounds, built-up land, forest area, and carbon demand on land.

In 1999, the EVI was developed by the South Pacific Applied Geosciences Commission (SOPAC) for the United Nations Environment Program (Kaly et al., 2004) to characterize the relative exposure of various types of environmental issues faced by 243 member countries. The findings of the EVI are used to provide solutions in reducing negative exposure towards the environment and its sustainability. In 2000 (and followed in 2001, 2002, and 2005), ESI, a measure of a country's overall progress towards environmental sustainability, was developed by the Socioeconomic Data and Applications Center (SEDAC) in collaboration with the Yale Center for Environmental Law and Policy and the Center for International Earth Science Information Network (CIESIN). This index provides a composite profile of national environmental surveillance based on the data

obtained from the database. There are three levels of this survey: ESI pilot study in 2000, 2001, 2002, and 2005 (SEDAC, 2019). At the same time, in the United States, the EQI was also developed; it was used from 2000 to 2005. The EQI considers five environmental domains: air, water, soil, development, and socio demography. The EQI also examines the differences between urban and rural environments by grouping districts into one of four cities according to continuum codes (RUCCs), from "highly dense" to "remote rural" areas (United States Environmental Protection Agency, 2014). The development of the use of global environmental indices can be seen in Figure 2.

The EPI has been used globally since 2006, starting with a pilot study to replace the ESI and the EQI. This measure is a performance index that serves as a benchmark for policymakers, environmental scientists, and the general public. As a performance index, it serves as a benchmark for policymakers, environmental scientists, and the general public. The ESI and EPI are projects under the auspices of Yale Center for Environmental Law and Policy (YCELP) and Yale Data-Driven Environmental Solutions Group at Yale University (Data-Driven Yale), Center for International Earth Science Information Network (CIESIN) at Columbia University, in collaboration with the Samuel Family Foundation, the McCall MacBain Foundation, and the World Economic Forum. EPI data collection is based on remote sensing collected and analyzed by researchers from observations through monitoring stations, questionnaires, and academic research. The EPI is used to describe the current position in the performance of the countries involved in environmental issues, with two primary objectives: environmental health and ecosystem sustainability.

Therefore, it can be seen that the effort towards environmental assessment is in line with two elements in geography: physical geography and human geography. In this article, the discussion focuses more on the construction of indices in terms of physical geography.

Measuring Components of Index of Physical Sustainability in Geography

Physical geography consists of a variety of elements such as the interaction between the earth and the sun, the occurrence of four seasons, the composition of the atmosphere, the atmospheric pressure and wind, the waves and climate disturbance, and other physical elements. The major divisions in the physical environment include four physical components of the earth or elements: the atmosphere (air), lithosphere (soil), hydrosphere (water), and biosphere (life). These elements do not interact on their own but rather with one another (Holden, 2011).

The first element, the atmosphere, is an air layer covering the earth at a thickness of about 1,000 km. Atmospheric layers have zero density and contain gas, water vapor, debris, and dust. The lithosphere is a solid, earthy surface consisting of rocks and minerals. This layer is part of the earth's crust and is located on top of the mantle layer. The hydrosphere is a water layerthat accounts for about 71% or two-thirds of the earth's surface (Hess, 2017). The last physical system of the earth is the biosphere, which is the layer consisting of all life, including human beings, plants, and microorganisms (Figure 3).

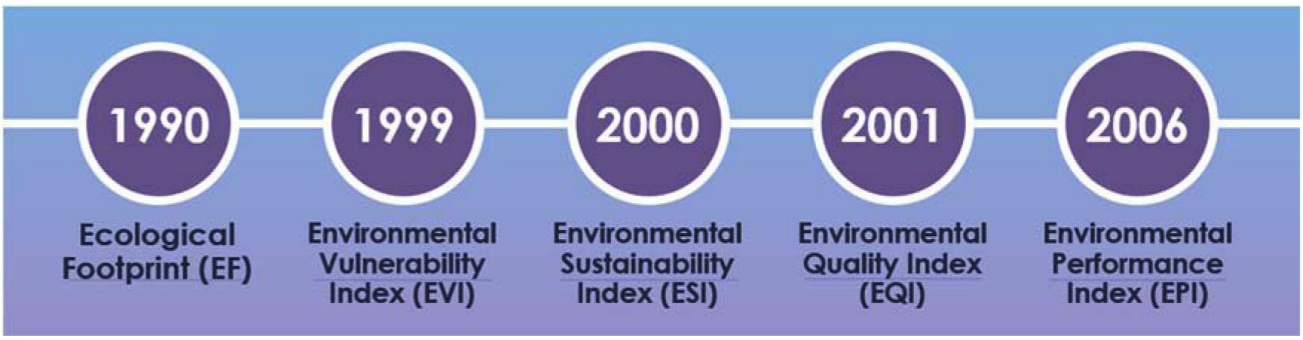


Figure 2. Development of Global Environmental Index Use

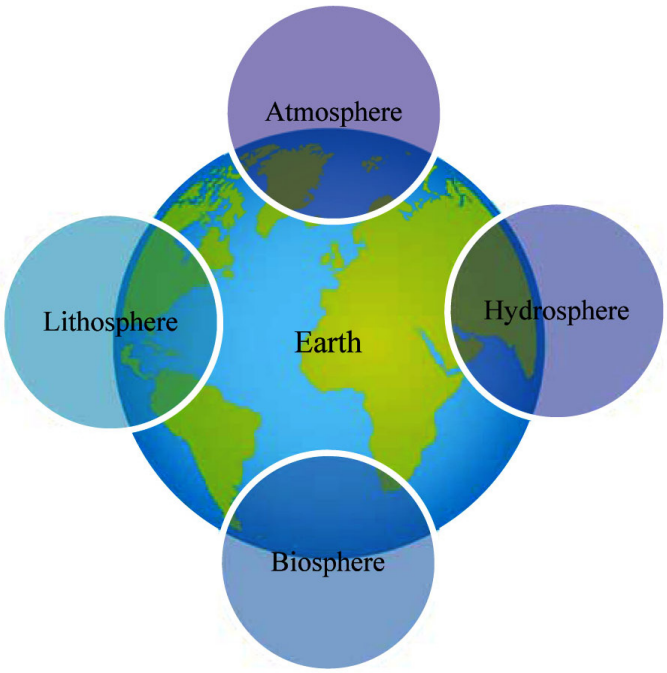


Figure 3. Component of the Earth's Physical System

In general, all systems in the physical system of the earth (consisting of the atmosphere, the lithosphere, the hydrosphere, and the biosphere) interact with one another and depend on one another to create balance and life in the ecosystem. Nonetheless, the sun is also the resource or main energy for the interaction of the earth's physical systems (Petersen et al., 2011). Rocks undergo a natural process of weathering to form soil to allow the plants to grow, whereas the sun influences the evaporation process, cloud formation, and raining events that enable trees to grow. Plants supply oxygen for animals and humans to breathe and provide food. Humans release carbon dioxide into the air and are used by plants to make their food. The hydrosphere becomes a habitat for aquatic life and is a source of human food. Ocean water supplies rain to the earth through evaporation and precipitation and many other examples of the interrelationships and interactions between the earth's systems. The importance of spheres is summarized in Table 1.

Thus, it can be concluded that the components of the earth's physical system—atmosphere, lithosphere, hydrosphere, and biosphere—in the physical geography are the most suitable components for the formation of the measuring components of environmental sustainability awareness index.

Components of the Physical Environment for Environmental Sustainability Awareness Index

The physical environment components of the environmental sustainability awareness index can be based on components and indicators in EVI, EQI, EPI, ESI, and EF, as were described in the Environmental Sustainability Awareness Index section.

The EF is an indicator that measures resource demand, human resource, and ecosystem services. In terms of demand, the EF measures individual or population demand for plant-based food and fiber products, livestock and fish products, timber and other forest products, space for urban infrastructure, and forests to absorb carbon dioxide emissions from fossil fuels. In terms of supply, the biocapacity of urban, country, or the country is represented by biologically productive land and sea areas (including forest area, grazing land, cropland, fishing grounds, and built-up land). The EF can be calculated based on the level of an individual, city, region, country, or the entire planet (Wackernagel & Rees, 1996; Wiedmann & Barrett, 2010).

The EVI features more of the relative exposure of various environmental issues experienced by

Table 1

The Importance of Atmosphere (Air), Lithosphere (Soil), Hydrosphere (Water) and Biosphere (Flora and Fauna)

Sphere	Importance
Atmosphere	– Important for all living beings to breathe. – Carbon dioxide gas is important for photosynthesis in plants. – Weather phenomena will occur in the atmosphere, such as evaporation, cloud formation, and precipitation processes, which are important to all life forms on earth as they provide water resources. – Atmospheric layers are the movement of waves that can facilitate in the telecommunication development. – In the atmosphere, which is in the stratospheric layer of the ozone layer is very important as a layer that absorbs ultraviolet light from the sun.
Lithosphere	– The habitat for living organisms such as humans, animals, and plants. – Its layer is rich in various minerals and rocks that can generate economic activities such as mining and construction. – Old weathered rocks will produce soils that are valuable for agricultural activities. – Soils that contain many nutrients are very useful for the growth of plants.
Hydrosphere	– The habitat for various organisms and water plants. – Rivers, seas, and oceans are important natural routes and transportation. – Provides sources of food such as fish, shrimp, crabs, and so on. – The sources of income for the people living near the sea, rivers, and lakes. – Able to develop hydroelectric power generation industry. – Provides water resources for domestic use of the population such as washing, drinking, bathing, and cooking. – Provides important materials in industries related to water supply such as steel, *batik* production, and beverage industry. – Provides water to irrigation systems in agricultural areas. – Water-bearing areas can be grown with crops such as jute, rice, mangrove, and palm.
Biosphere	– Humans and animals supply carbon dioxide to the atmosphere, which is useful for the photosynthesis of green plants, the process by which plants make their food. – Plants release oxygen to the air, which is used by humans and animals for breathing. Plants are also important for providing food to humans and animals and, as well, raw materials for the industry. – Bacteria and fungi also act as agents to degrade and decompose dead animals and plants to provide nutrients and soil fertility to boost the growth of plants.

243 member countries. The EVI results are used to provide solutions for reducing negative exposure to the environment and its sustainability (Kaly et al., 2004). On the other hand, the ESI comprises five components (the environmental system, reducing environmental stress, reducing the damage done by humans, social effects, and institutional capacity). These components are represented by 21 indicators: air quality, biodiversity, soil water quality water quantity, reduce air pollution, reduce ecosystem pressure, reduce population surplus, reduce waste and consumption pressure, reduce water pressure, natural resource management, environmental health, basic human resources, reduce natural disaster vulnerability, the environment, governance, eco-efficiency, the private sector, responsiveness, science and technology, international participation in joint ventures, greenhouse gas emissions, and reducing borders and environmental stress. In terms of global environmental index, the ESI is an index used from 1999 to 2005 that identifies 21 elements of environmental sustainability, including natural resources, past and present levels of pollution, environmental management, contribution for global community protection, and the ability of

Table 2

Components of Physical Environment of the Environmental Sustainability Awareness Index

Researcher	Index	Year	Component	Indicator
Wackernagel & Rees (1996)	Ecological Footprint (EF)	1990	– Measures the demand in and supply of nature. – Tracks the use of six categories of productive surface areas: cropland, grazing land, fishing grounds, built-up land, forest area, and carbon demand on land.	
South Pacific Applied Geosciences Commission (SOPAC)	Environmental Vulnerability Index (EVI)	1999	– Vulnerability of the environment to natural risks and to humans. – Effects on the physical and biological aspects of the ecosystems, diversity, populations and organisms, communities, and species.	
Collaboration between Yale Center for Environmental Law and Policy (YCELP), Center for International Earth Science Information Network (CIESIN) and World Economic Forum	Environmental Sustainability Index (ESI)	2000, 2001, 2002, 2005	*5 components* – Environmental Systems – Reducing Environmental Stresses – Reducing Human Vulnerability – Social and Institutional Capacity – Global Stewardship	*21 indicators* – Air Quality – Biodiversity – Land – Water Quality – Water Quantity – Reducing Air Pollution – Reducing Ecosystem Stress – Reducing Population Pressure – Reducing Waste & Consumption Pressures – Reducing Water Stress – Natural Resource Management – Environmental Health – Basic Human Sustenance – Reducing Environment Related Natural Disaster Vulnerability – Environmental Governance – Eco-Efficiency – Private Sector Responsiveness – Science and Technology – Participation in International Collaborative Efforts – Greenhouse Gas Emissions – Reducing Transboundary – Environmental Pressures

Continued Table 2

Researcher	Index	Year	Component	Indicator
Sustainable Development of the International Institute for Sustainable	Environmental Quality Index (EQI)	2001-2005	*4 domains* – Air domain – Water domain – Land domain – Sociodemographic Domain	
Yale Centre of Environmental Law & Policy	Environmental Performance Index (EPI)	2006-2018	*10 issues* – Air Quality – Water & Sanitation – Heavy Metals – Agriculture – Water Resources – Air Pollution – Climate & Energy – Fisheries – Forests – Biodiversity & Habitat	24 indicator – Household Solid Fuels – PM2.5 Exposure – PM2.5 Exceedance – Drinking Water – Sanitation – Lead – Sustainable Management Index – Wastewater Treatment – NOx – SO2 – N2O – B.C. – Methane – CO2 from Power – Total CO2 – Regional MTI – Fish Stock Status – Tree Cover Loss – Sp/ Habitat Index – Represent Index – Species Protection Index – Biome Protection Global – Biome Protection National – Marine Protected Areas

the community to improve environmental performance from time to time (Yale Center for Environmental Law and Policy, 2005).

The EQI is measured through five environmental domains: air, water, soil, development, and socio demography. The EQI also examines the differences between urban and rural environments by grouping districts into one of four cities according to continuum codes (RUCCs), from 'highly dense' cities to 'remote rural' areas (U.S. Environmental Protection Agency, 2014). The development of the use of this global environmental index can be seen in Figure 3.

In 2006, the EPI, which began with a pilot study, replaced the EQI with 10 categories of issues—air quality, water quality, heavy metals, biodiversity and habitat, forests, fisheries, climate and energy, water pollution, water resources, and agriculture—as well as 24 indicators. In short, each level of the index has similarities and changes according to the current state of demand. A summary of the components of the physical environment of the environmental sustainability awareness index is presented in Table 2.

Importance and Limitations of the Construction of Environmental Sustainability Awareness Index

The construction of an environmental sustainability index is a process of developing an instrument for measuring the responsibilities of a country and certain institutions in the field of social and environmental issues. However, there are advantages and limitations of using the environmental index. According to the European Commission (2015), the advantage of using the environmental sustainability index is that it helps synthesize complex scientific information into easily understood forms or ways. In addition, the index helps translate various environmental indicators into simple, easily accessible systems. The index also provides information that can be easily communicated to the public. For example, when the air quality index is poor or hazy, people are not allowed to do an open burning (Ministry of Energy, Science, Technology, Environment and Climate Change Malaysia, 2018). This situation, at the same time, can increase public awareness to take care of the environment.

However, there are limitations to the use of this environmental index, which might be too general and unscientific as it involves multiple indicators. Therefore, it is important that researchers who want to study an index focus on a specific aspect, such as an area of social. In addition, a single index may not tell the whole story, for example, the index may indicate that a river is not suitable to be used as drinking water, but the river may be good for swimming and healthy habitat for fish and macroinvertebrates (European Commission, 2015). A summary of the advantages and limitations of using the environmental index is shown in Table 3.

Conclusion

In conclusion, the construction of an environmental sustainability awareness index, especially involving elements of the physical environment, is important in Malaysia in its attempt to measure the responsibilities of institutions and the public in the social and environmental aspects of the country. The construction of a sustainability index can provide information in the form and way that is easy for the public to understand while increasing their awareness of caring for the environment. As explained earlier, it can be seen that the aspect of environmental assessment is in line with two geographical elements (the aspects of physical geography and human geography).

Assessments on the aspects of physical geography in Malaysia can be seen through the production of the Air Pollution Index (API), Water Quality Index (IKA), Marine Water Quality Index (MWQI), National Drinking Water Quality Standards, and EPI. In other countries, the EVI, EQI, EPI, ESI, and EF have been used to measure predefined indices.

However, in terms of human geography in Malaysia, the assessments are still isolated in terms of the production of environmental awareness indicators, the stage before the index is produced. Therefore, research on the environmental sustainability literacy index is important in helping the country achieve a first-class society that recognizes and values the culture, arts, and heritage, as well as the history of the country, races, and religions, indirectly preserving and conserving the environment to be appreciated by the next generation.

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This report is our original work.

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This study was approved by the institution.

References

Allport, G. W. (1954). *The nature of prejudice*. Perseus Books.

Arcury, T. A., Scollay, S. J., & Johnson, T. P. (1987). Sex differences in environmental concern and knowledge: The case of acid rain. *Sex Roles, 16*(7/8*),* 463–472.

Arora, N. K. (2018). Environmental sustainability - Necessary for survival. *Environmental Sustainability 1*, 1–2. https://doi.org/10.1007/s42398-018-0013-3

Barnhart, C., & Thorndike, B. (1962). *Coprehensive desk dictionary.* Doubleday and Co.

Brundtland Commission & Gro Harlem Brundtland. (1987). *Our common future.* United Nation Retrieved from http://www.un-documents.net/our-common-future.pdf

European Commission. (2015). *The pros and cons of an Environmental Index*. https://ec.europa.eu/economy_finance/publications/european_economy/forecasts/index_en.htm

Hazura, A. B. (2009). *The relationship between religious appreciation, life values and environmental knowledge of Muslim students with attitudes and behaviors* (Unpublished doctoral dissertation). Center for Educational Studies, Universiti Sains Malaysia.

Hess, D. (2017). *McKnight's physical geography: A landscape appreciation* (12th ed.). Pearson.

Herremans, I. M., & Reid, R. E. (2002). Developing awareness of the sustainability concept. *The Journal of the Environmental Education, 34*(1), 16–20.

Holden, J. (2011). *Physical geography: The basics*. Routledge.

Hopkins, C., & McKeown, R. (2002). Environment education for sustainability: Responding to the global challenges. In Tilbury, D., Stevenson, R. B., Fien, J., & Schreuder, D. (Eds.), *Education and Sustainability nResponding to the Global Challenge* (pp. 13–24). IUCN Commission on Education and Communication.

Huckle, J. (2009). Sustainable Schools: Responding to new challenges and opportunities. *Geography, 94*(1), 13–21.

Isa, M. Y., & Ahmad, S. N. (2015). Non-Muslim consumer indices of halal food products in Malaysia. In *Proceeding The 2nd International Convention on Islamic Management* (1–9). World Academy of Islamic Management

Joshi, U, (2009). Education for Sustainable Development-The role of the university. *International Forum of Teaching and Studies, Marietta* (pp. 62-69). Marietta, Ga. American Scholars Press.

Kalkan, S., & Demirbas, E. (2017). An empirical assessment on environmental awareness of school managers and teachers as stakeholder of private schools. *Research Journal of Business and Management (RJBM*), *4*(3), 310–325.

Kaly, U. L., Pratt, C. R., & Mitchell, J. (2004). *The demonstration environmental vulnerability index (EVI) 2004* (SOPAC Technical Report). South Pacific Applied Geoscience Commission.

Katiman, R. (2002). *The basic principle of the human environment.* Universiti Kebangsaan Malaysia.

Kohlberg, L. (1958). *The development of modes of thinking and choices in years 10 to 16* (Unpublished doctoral dissertation). University of Chicago.

Kollmuss, A., & Agyeman, J. (2002). Mind the gap: Why do people act environmentally and what are the barriers to pro-environmental behavior? *Environmental Education Research, 8*(3), 239–260.

Laily, P. (2009). *Sustainable use between reality and challenge.* Universiti Putra Malaysia.

Laws of Malaysia. (1974). *Environment Quality Act 1974.* Pencetakan Nasional Malaysia Bhd. http://www.agc.gov.my/agcportal/uploads/files/Publications/LOM/EN/Act%20127.pdf

Ministry of Energy, Science, Technology, Environment and Climate Change Malaysia. (2018). *Air Pollutant Index (API).* Department of Environment, Ministry of Energy, Science, Technology, Environment and Climate Change Malaysia. https://www.doe.gov.my/portalv1/en/info-umum/english-air-pollutant-index-api/100

Moroye, C. (2005). Common ground: An ecological perspective on teaching and learning. *Curriculum and teaching dialogue, 7* (1/2), 123-139.

Omar, O. (2005). *Education for sustainable development: The roles of universities as regional centre of expertise.* (PhD Thesis). Universiti Sains Malaysia.

Petersen, J. F., Sack, D., & Gabler. R. E. (2011). *Physical geography.* Thomson Brooks.

Rauch, F. (2002). The potential of education for sustainable development for reform in schools. *Environmental Education Research, 8*(1)*,* 43–51.

Rosta, H., Lim, K. H. & Fadhilah, O. (2011). Environmental knowledge and attitude among student in Sabah. *World Applied Science Journal, 14,* 83–87.

Scoullos, M. & Malotidi, V. (2004). *Handbook on methods used in environmental education and education. Athens: MIO-ECSDE*. http://www.medies.net/_uploaded_files/publications/HANDBOOK._ENGpdf.pdf.

Socioeconomic Data and Applications Center. (2019). *Environmental Sustainability Index (ESI).* Columbia University. https://sedac.ciesin.columbia.edu/data/collection/esi/

Sterling, S. (2003). *Whole systems thinking as a basis for paradigm change in education: Explorations in the context of sustainability.* University of Bath.

U.S. Environmental Protection Agency. (2014). *Environmental Quality Index overview report.* U.S. Environmental Protection Agency.

Wackernagel, M. & Rees, W.E. (1996). *Our ecological footprint: Reducing human impact on the earth. Canada*: New Society Publishers.

Weber, Estelle L. (Ed.), (2009). *Environmental ethics, sustainability and education*. Oxford: Inter-disciplinary Press. Wiedmann, T., & Barrett, J. (2010). A review of the ecological footprint indicator—perceptions and methods. *Sustainability, 2,* 1645–1693.

World Economic Forum. (2016). *Future of jobs report: Employment, skills and workforce strategy for the fourth industrial revolution.* World Economic Forum

Yale Center for Environmental Law and Policy. (2005). *Environmental Sustainability Index (ESI)*. Retrieved from https://sedac.ciesin.columbia.edu/data/collection/esi/

Yeoh, B. G. (2005). Environmental education and awareness efforts in the Community Recycling Program in Penang. In *Proceeding of the Bandar Lestari- Environment Award Ceremony, Marriott Hotel Putrajaya* (pp.156-167). Department of Environment, Malaysia.

Zurina, M. & Norjan, Y. (2003). Kesedaran alam sekitar: Tinjauan awal di kalangan kalangan pelajar Universiti Kebangsaan Malaysia. *Prosiding Seminar Kebangsaan Pengurusan Persekitaran. Bangi: Universiti Kebangsaan Malaysia*. (pp. 137-145). Universiti Kebangsaan Malaysia