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INTROPica

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FORESTS: HUMAN HEALTH AND WELLBEING

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FORESTS: HUMAN HEALTH AND WELLBEING

Forest belongs to nature to be protected for the next generation as it brings life prosperity that generate wonders for your well-being. Trees are good for our mental and social well-being, which, when you are around, will make you happy. This situation, in fact, contributes to better health, ingenuity and even kindness. It may be something unique to be among trees, which in this issue is given in detail.

We are not surprised that forest is now being developed in an urban area by adapting residential areas, parks and offices to tree planting. For example, Blue-Green infrastructure was designed as a solution to coping with flood issues, which studies said that this approach helps natural-based water flows. In their residential area, residents have fallen the effect of heat generated by urban development, for example in the surrounding industrial region, buildings and construction sites. Sustainably managed forest timber construction provides a therapy that connects nature, people and wood-materials. The furniture industry has revealed that environmental factors have a huge effect on the creation of good physical health, mental health and well-being, which was generated a long time ago. In order to encourage better well-being, well-developed timber construction can promote less heat timber building for people, minimise carbon pollution and create a light and open climate.

As society began preferring nature-based products and services, forest area for economic enterprises is becoming a high-spot area. As a result, the loss of forest resources that functionally break down forests decreases the inability to support people now and in the future. It is becoming a challenge for scientists to provide know-how and scientific expertise to protect natural environments through the conservation of forest resources. Scientists agreed that sustainable forest management should be continuously practised in harvesting timber in the direction of ecological sustainability.

Remote sensing technologies, such as the use of higher resolution imaging, now are part of the monitoring process. Many industries began applying the concept of deep learning and neural network rules to sustainable forest management systems in autonomous unmanned aerial vehicles (UAV). In the meantime, recent IoT technology development, using remote and automated systems, makes forest protection more effective. Moreover, incorporated Artificial Intelligence (AI) in the machine enhances the planning of urbanisation and protects more forests.

Last but not least, by using the idea of Corporate Social Responsibility (CSR), there was another way to return the precious nature to its roots. CSR develops aligned with goals setup by Sustainable Development Goals (SDGs) (after Covid-19 pandemic version). This topic has provided an opportunity to investigate the involvement of timber-related companies and to assess the degree of participation based on their size of industry.

Forest for long-lived and well-being

INTROPica
HIGHLIGHTS

TREES, SCENTS AND HUMAN WELLBEING

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Introduction

Trees have many functions, which provide important services to the ecosystem such as food, timber for building materials, fibers for material and paper and soil stabilizer. In addition, they also play very important role in hydrological cycle. These important functions of trees acted as environmental services provider to the surroundings.

Tree canopies provide shading that reduce both local surface temperature and urban heat island effects. Leaves of the trees also release water through evapotranspiration process which subsequently deliver cooling effect to the surroundings environment. They also absorbed gaseous pollutants that produced by the cars and filter the particulates such as ash and dust (NorDina et al., 2016). This activity improves the ambient environment and make available healthy living to the inhabitants of the area.

Trees absorb carbon dioxide and produce oxygen during the process of photosynthesis, and they sequester carbon in their trunks. This process helps to reduce the carbon dioxide which is one of the most common greenhouse gas contributing to climate change.

Tree roots also play important role in improving the soil below the ground. Roots provide organic material to soil and carbon sources for the microorganism living in the soil. Increment in soil microorganism enhances nutrient recycling and improve soil health. Healthy soils promote healthier tree. Tree roots create space in the soil allowing oxygen into the soil pore and water flow into the smaller space between the soil particles. This improve the soil structure and provide suitable condition for tree growth.

Trees are also planted for their beauty and esthetics. The beautiful flowers provide color and character to the surroundings. The gigantic structure of tall tree brings a huge sense of awe and humility, so it brings out feeling of spirituality on the impressive structure that form the tall trees.

Trees are planted for the distinct aroma and scents. These scents may be due to emission of volatile organic compounds produced from flowers, foliage, barks or resins from the trunks (Maffei et al., 2011). These scents distinguish the smellscape, enhance the character and provide attraction to the visitors of the place. They are also used as flavors for food and perfumes (Dunkel et al., 2009). This article aims to describe the role of scents produce by trees and their functions in improving the human wellbeing.

Scents Chemistry

Many trees produced scents that are pleasant to human and animals but there are also scents that offensive to human usually smells like carrion. These scents are volatiles chemicals compound composed of isoprenoids, benzenoids, phenylpropanoids and fatty acid derivatives that are produced and emitted directly to the air by plants. These compounds are small molecules with low boiling points and high vapor pressure that facilitate volatility. They are derived from synthesis of different biochemical pathways and contain different chemically functional groups (Gang, 2005). These volatiles compound not only produce from flowers but also from different parts of the tree such as seeds, leaves, bark and roots.

There are many possible reasons why plants produce volatile organic compounds. One of the reasons is that these volatiles attract pollinators and seed dispersals (Junker and Parachnowitsch, 2015). For species that are not able to self-pollinate, attraction to pollinators is crucial for reproduction. Second function is to attract the natural enemies of herbivores (Keiser, 2006). The chemical signals released by the host plants enable the predator able to find its host. These volatiles play an important role in interaction between plants and insects. The third function of the volatiles chemicals is to prevent herbivory near to plant by defending from insects or microbes (Fineschi, and Loreto, 2012). These volatiles are produced by the reproductive tissue to protect the vital organs against herbivores (Wink, 2003).

Table 1. List of tree species which produce scents from various plant parts.

Species	Plant Part	Main Chemicals	Traditional Use
Aquilaria malaccensis Karas	Infected stem	α-agarofuran, β-agarofuran, agarospirol	Traditional health remedy, incense
Cananga odorata KenagaS	flower	Linalool, β-caryophyllene	Fragrance, Flower bath
Dryabalanop aromatica Kapur	resins	β-caryophyllene, α-humulene, caryophyllene oxide	Fragrance

Species	Plant Part	Main Chemicals	Traditional Use
Fragrea fragrans *Tembusu*	flower	Linalool, nerol, α-terpineol, eugenol, β-bisabolenol	Fragrance
Gardenia tubifera *Chempaka Hutan*	flower	Linalool, 3-phenyl 2-propenal, α -copaene	Fragrance
Magnolia champaca *Chempaka*	flower	Quercetin, sitosterol, linalool	Frangrance, Flower bath
Mimusops elengi *Bunga Tanjung*	flower, Seeds	Ursolic acid, β-sitosterol, lupeol	Ayuverdic medicine
Plumeria obtuse *Fragipani*	flower, bark	Oleanolic acid, ursol acid (pentacyclic triterpenoids)	Flower bath

Sources: Baliga et al., (2011); Nor Azah et al., (2018); Nuanyai et al., (2010) Tan et al., (2015)

Scents and Human Wellbeing

Human has been using aromatic plants long time ago in religious rituals, funerary, medical remedies and food ingredients. Camphor extracted from Dryabalanobs aromatica has been mentioned in religious texts such as Bible and Quran (Schoff, 1922). Camphor also has been mentioned in the Hadith of the prophet Muhammad (s.a.w) as part of scents to be sprinkled in the wrappings of a dead body for burial (Talal, 2020).

These aromatics have been synonymous with high income, exclusivity and luxury where these aromatics substances were believed to be able to prevent diseases and prescribed as expensive medical treatments to the nobles rather than ordinary people (Freeman, 2015). These aromatic plants were also used as fragrances to scents the houses of the aristocrats.

Agarwood also known as aloeswood that contain embedded resin (from infected wood). The resin can be extracted from stem or branches of Aquilaria malaccensis which has been used for many purposes since ancient times (Figure 1). These precious woods were traded across the maritime silkroad where these agarwoods were sourced from the Indo-Malay region and transported to the Middle East by the Arabian traders plying the water ways of the Arabian Sea, Indian Ocean and Straits of Malacca. This trading activity was mentioned in the Ibn Batutta travelogue named Al Rihlah (López-Sampson and Page, 2018). The agarwood was graded based on quality and used for perfumery, medical remedies and as gifts or tributes.

Photo: Ahmad Ainuddin
Figure 1. Agarwood from *Aquilaria malaccensis* that embedded with dark color resin.

Many trees are grown for their aromatic scents from the flowers. In the old Malay manuscripts such as Bustan AsSalatin (The Garden of Kings) authored by Nuruddin ArRaniri dedicated to Sultan of Acheh, Sultan Iskandar Thani and Malay Annals called Sulalatus Salatin (Genealogy of Kings) which was written as a historical record on the establishment and development of the Malacca Sultanate, mentioned trees that were grown in the palaces garden (Zakaria et al, 2012). Mimusops elengi (Figure 2), Michellia champaca and Cananga odorata are multi-purpose trees planted for their scents and medicinal values (Table 1). The flowers were processed to produce oils for perfumes and the fresh flowers are used for fragrant garlands making, like decorated-necklaces. These trees are still being planted in the Malay gardens in the rural areas (Md Syed et al., 2019). Trees are also planted for specialized gardens. These therapeutic gardens are designed for people with disabilities such as vision impaired which can make use of their other senses such as olfactory ability. These gardens are designed to stimulate all senses especially the non-visual ones. Trees and shrubs with different scents are planted along the track to guide the users. These scents can help to stimulate visual images based on smells (Kopeva et al., 2020). Brightly coloured flowers can enhance the vision of the partial impaired users. Other parts of the tree such as sound of the rustling wind through the tree canopies can also stimulate the hearing senses.

Source: commons.wikimedia.org/wiki/Category: Mimusops_elengi

Source:en.wiktionary.org/wiki/Mimusops_elengi

Figure 2. Flowers and fruits of Bunga Tanjung, *Mimusops elengi*, a multi-purpose tree with aromatic scents.

In the elderly care homes, gardens which are planted with aromatic trees produce scents can help to relive the memory and trigger the brain to reminisces their past lives. The process of reminiscing helps to improve the brain ability to remember (Herz, 2000). Certain scents can invoke memories which lead to emotional intensity feelings. This help to improve cognitive functions of elderly with dementia symptoms leading to improve quality of life (Edwards, et al., 2012).

Scents from the trees can be used to change annoyance to environmental disturbances. Study by Ba and Kang (2019) on effect of a fragrant tree on the perception of traffic noise shows that the aromatic scents produced by the street plants was able to increase overall comfort to the street and decrease in the annoyance cause by the traffic noise. This finding can help in designing better streets smellscape and improve pleasentness in urban environment

Conclusion

Trees play important functions especially in aesthetics and improving of man-made environment. Trees produce scents and fragrances from emission of volatiles organic compounds from plant parts such as flowers and leaves. These volatiles organic compounds play important role in the reproduction process by attracting pollinators and protecting trees from its enemies. Human has been exploited these chemicals and scents from the trees since ages for many purposes and to improve its well- being. It is important that these trees be conserved and protect so that their benefits can be continued for coming generations.

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HIGHLIGHTS

BEAT THE HEAT: URBAN BLUE-GREEN INFRASTRUCTURE

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Introduction

The urban population is projected to increase by 2.5 billion between 2018 and 2050, where Asia and Africa are associated with 90% of the predicted population growth (United Nations, 2018). As more than 60% of the world population is projected to be living in cities (United Nations, 2018), the urban residents are highly exposed to extreme climates much more than those in rural due to the Urban Heat Island (UHI) effect. UHI is the phenomena where the cities are experiencing warmer and dryer conditions than rural areas, especially during night time (Block et al., 2012). Most of the cities experiencing UHI has no dependency on the size of the city nor its climate (Debbage and Shepherd, 2015; Wang et al., 2016).

Urban Heat: Human Health and Wellbeing Implications

Extreme event such as the heatwave is associated with extreme heat conditions. Heatwave event is technically defined as temperature that is greater than the usual temperature of an area for three consecutive days or more with its daily maximum temperature at ≥ 92.5th percentile (Yang et al., 2019). The heatwave is becoming more critical, where UHI phenomena exacerbate by global warming can increase in thermal load in cities, that leads to more extreme heatwave events. This poses negative impacts on the environment as well to the urban residents' health and wellbeing as the elevated temperature can be a discomfort to them. Moreover, this is critically important as the heat-related diseases such as heat stress and heat stroke are typically affecting human especially during the heatwave events where in extreme cases it may lead to mortality (Hopp et al., 2018). Most importantly, vulnerable residents such as children, elderly and individuals with pre-existing diseases are at greater health risk during the heatwave (Agarwal et al., 2016).

Urban Blue-Green Infrastructures

With the predicted increase in heatwave frequency and intensity (Luber and McGeehin, 2008), this leads to a question, "How do cities keep cool in hot weather?" Therefore, it is very important that smart climate-strategies to be implemented by cities in minimising its impact especially on the urban residents. One of the strategies for cites to mitigate the impact of extreme weather events and UHI is through the use of nature-based solution such as the Blue-Green Infrastructure (BGI) (Sanusi & Bidin, 2020). BGI can be defined as 'visually green and naturally living' and 'water-related infrastructures (Qi et al., 2019). Components of BGI include the green infrastructure such as trees, grass, shrubs and vertical greening while blue infrastructure consists of the waterbodies element in cities. These BGI components provide environmental and community benefits such as for microclimate mitigation, carbon sequestration, biodiversity and stormwater runoff reduction (Wang and Banzhaf 2018; Aida et al. 2016; Dobbs et al. 2011). In addition, BGI enhances the health and wellbeing of urban residents by improving their thermal comfort (Sanusi et al., 2017; Morakinyo et al., 2018; Fung and Jim, 2020).

Ongoing Studies on Urban Blue-Green Infrastructures

Multiple studies are currently being investigated on the influence of different urban BGI on human health implication specifically on the human thermal comfort. For example, these two studies are currently ongoing and (Figure 1), observing different:

1. BGI elements: This study involves the investigation of different BGI elements such as trees, grass and waterbody.
2. Planning designs: This study looking at a different tree planting design. It involves the use of different tree species and tree planting encompasses trees in isolation or cluster.

These two studies are highlighted as these studies represent the components of BGI and how BGI contributes to microclimate mitigation and human thermal comfort improvement. As such, the findings of these two studies are expected to add on the current knowledge of the influence of BGI on urban cooling and human thermal improvements.

Figure 1: Some of the sampling sites for current studies at Putrajaya Botanical Garden.

Conclusion

Future studies on BGI hopefully can be served as evidence that the management of BGI components in cities can provide urban cooling and potentially to mitigate UHI and extreme heat events. This will definitely implicate the urban planners and managers in their future planning and management of cities to beat the heat and at the same time to improve human health and wellbeing.

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RECREATION BENEFIT AND WELL-BEING

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Natural resources such as wetland, lakes, river or even sea as well as forest are public goods that are widely used for recreational purposes. In a developed country, fewer resources are being allocated towards the conservation of green environment as compared to improving the livelihood of poor and rural households, transportation and logistics infrastructure or even human capital development. The environment sector is considered important, but not crucial.

Today, the demand for recreation is increasing probably as escapism from hectic lifestyles and concerns regarding the health condition. The continuously rising demand from outdoor recreation and fewer allocations put significant importance to have a reliable measurement of the natural resources economic value (Das, 2014). One of the activities that people engaged during their leisure time is recreation. Recreation is a word derived via Old French from Latin recreare, which means create again, renew. Typically, when a person engages in recreational activities, it brings positive outcomes to the individual's wellbeing. Previous literature shows that the basis or purpose of recreation is the contribution to human health and well-being. Here are some of the benefits of recreation.

Physical Benefits

In order to have a good and healthy body, individuals of all ages should regularly perform physical activity. Among its benefits are it reduces the risk of premature death, coronary heart, stroke, hypertension, diabetes as well as obesity. Consistent recreation in a natural setting is good because of the fresh air intake as well as the serenity the place has to offer.

In the long-term, there should be a decline in obesity rate and subsequently, a reduced cost in public health care. For example, moderately active retirees have significantly lower health care cost than sedentary retirees (Outdoor Industry Association, 2017). Physical activity should be made as a lifestyle instead of a weekend activity.

Social Benefits

Social interaction is a relationship between two or more individuals. According to Maslow Hierarchy of Needs, every human needs a relationship in order to feel a sense of belonging and acceptance. In today's world where life is fast-paced and technology has taken over the way people communicate; it is easy to be surrounded by people yet feel so alone. The absence of social interaction could lead to loneliness and potentially depression (Maslow, 1943).

Forest offers a positive experience as a place to do physical activities and enjoy nature. It is a place where people can meet other people with the same interest, such as bird watching and trekking. By meeting, they will communicate and exchange opinions and ideas and build a relationship. It will enhance their social network and provide them with a sense of belonging. Family are the foundation of a society. A happy family is important in children's well-being and development. Activity such as trekking with family and friends over the weekend rekindled the relationship and stamped a loving and lasting memory. They will feel contented and energised knowing that they are important in someone's life. Besides, they will feel attached to the park as it manages to reduce their sense of loneliness.

Intellectual Benefits

Participating in recreation activities will improve the overall individual's self-esteem. A high-adrenaline activity such as white-water rafting requires that the person be confident, brave, and trustworthy. On the other hand, hiking requires a person to be a risk-taker, quick in decision making and also confident. Outdoor recreation can help improve a youngster's intellectual well-being. It teaches vital life skills such as tolerance, competitive, sportsmanship as well as teamwork. These positive attitudes will mould them into a better adult and perhaps a better leader. It can also reduce the risk of illegal substance abuse and suicide among youngsters (McKay, 2012).

Emotional Benefits

Usually, people participate in recreation because of fun. However, it also manages to reduce stress, anxiety and depression. This is due to the cortisol hormone released during the physical activity. An example of stress reliever activity is walking in a forest while enjoying nature. There are many types of activities that people engaged according to their preferences. A positive and enjoyable activity can bring a long-lasting feeling. An individual will feel satisfied and contented when they accomplished their choice of activities. They will have better sleep that will lead to feeling more energised, attentive, and able to think creatively.

There is strong evidence that the forest has a positive impact on human health benefits and psychological well-being. There is the belief that taking time out in nature, specifically a forest area, can affect human well-being. Forests provide enormous possibilities to improve human health conditions. Forest may also play an essential role in health promotion and disease prevention. The results of a vast amount of research show that forest visits promote both physical and mental health by reducing stress.

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HUMAN HEALTH AND SUSTAINABLE FOREST MANAGEMENT

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Introduction

Forests are a home to the world's terrestrial biodiversity. This ecosystem that encompasses goods and services is beneficial to human life, both in urbanised and rural areas. These benefits include supplies of food, sources of traditional herbal medicines as well as recreational use in providing healthy lifestyles.

Maintaining forests for human wellbeing is a big responsibility to forest managers, and it is not exceptional to us as users of goods and services provided by forest. The whole concept revolves around resource security and sustainable forest management (SFM). Forest legislation in Peninsular Malaysia delineated about 43.6% of the total Peninsular land as forested area in 2018 (Figure 1). In an effort to safeguard this forested area, several relevant policies and ordinances were used and enforced, including National Forest Policy (1978), National Forestry Act (1984), National Policy on Biological Diversity (1998), National Park Act (1980), Environmental Quality Act (1974), Protection of Wildlife Act (1972), Aboriginal Peoples Act (1954), and Occupational Safety and Health Act (1994). Negligence in practising SFM will threaten the existence of our forest resources, and thus would adversely affect the forests' benefits and therapeutic effects enjoyed by humankind.

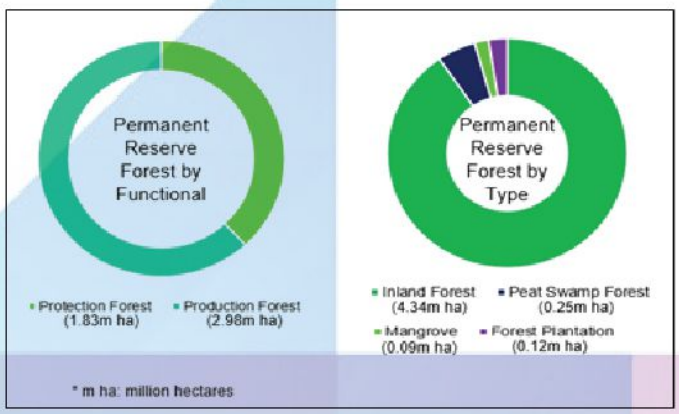

Figure 1: Statistics on permanent forest reserves in Peninsular Malaysia (Source: FDPM, 2020).

Forest as Natural Remedies

Strong inputs from social sciences and an integrated, all-encompassing approach is crucial in preserving forests as an essential asset for human enjoyment and wellbeing. This can be better understood by examining the forests' therapeutic effects. Forest therapy research, an apparatus for gauging therapeutic effects, has been driven by an interest in the emerging physiological benefits of nature: biodiversity and ecosystem functions seem to provide an alternative stress relief and natural remedy for human ill health (Lee et al., 2014; Mylek and Schirmer, 2015; Rajoo et al., 2019; Yu and Hsieh, 2020). Previous research found out that a stress-free mind increases positive emotions, and thus is beneficial for high-level cognitive (Rajoo et al., 2019; Yu and Hsieh, 2020) and psychomotor functioning (Mylek and Schirmer, 2015). The Forest School approach to education supports the outdoor classroom learning; this new trend is growing worldwide, and it apparently leads to positive changes in students' soft skills (O'Brien, 2009; Rajoo et al., 2019). Despite all the benefits, forests are threatened by logging operations and conversion of jungle land to other use such as agriculture, which will have an impact on forest ecosystems and biodiversity, and in severe cases, may reduce the therapeutic effects on human wellbeing.

Current Threats

In dominant forested areas (as in Figure 1), production forests have been gradually cleared of tree stands since 1901, causing the forest cover to diminish (Hamid, 2016; FDPM, 2001; Smith, 1954). The loss of tree-covered area may occur for many reasons, including deforestation, fire, and logging within the course of sustainable forestry operations. In the sustainably managed forests, the loss will eventually turn into gain, when young trees grow large enough to achieve canopy closure.

In detecting forest cover changes due to deforestation, geospatial technologies are commonly used, including remotely sensed imagery data analysis, Geographic Information System (GIS), and several internet access platforms for live and latest change detection such as Google Earth Pro (GE) and global forest watch (GFW), to name a few (Atiqah et al., 2020; Rhyma et al., 2019; Zulfa and Norizah, 2018; Sidhu et al., 2018).

Application of GE in detecting forest changes has been examined and deemed an acceptable tool by Atiqah et al. (2020). GE offers users a window to travel the world on their seats. Forest changes can be viewed with Historical Imagery under the View tools. Users can find images of forests and use the date bar to observe forest changes. Forest losses and gain can be observed by interpreting the shapes and textures of the available images (Figure 2).

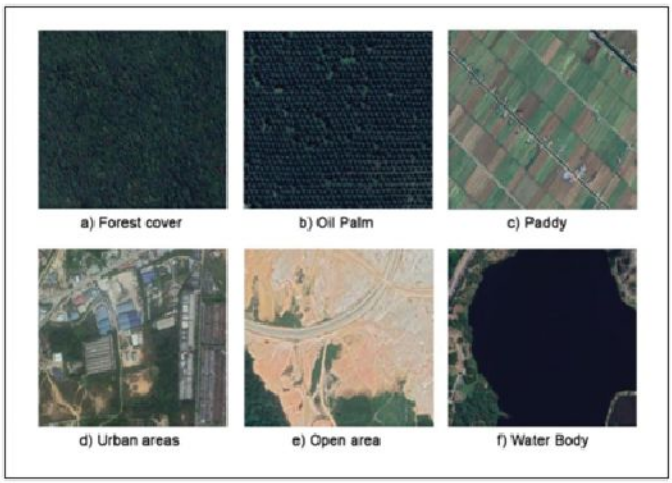

Figure 2: Examples of shape and texture in interpreting forest cover and land use changes with GE imagery (source: Atiqah et al., 2020).

The Hutan Simpan Ayer Hitam Reserve Forest (HSAH), known as a lung for Klang Valley, is taken as an example for observing the forest cover changes with GE imagery analysis (Figure 3). The latest image for this area was captured in February 2020. The latest changes for this forest were recorded in December 2003, with urbanisation being observed in the surrounding area of HSAH, which started in the 1990s. The earliest image for HSAH was recorded by GE in 1984; it shows the area was under timber harvesting, with logging roads and skid trails, which still exist nowadays (shown by yellow arrow).

HSAH has been used by Rajoo et al. (2019) as a study site for forest therapy research. The study yielded positive results indicating that the participants' stress was reduced after several activities in the forest; such finding shows that a well-managed forest (i.e. characterised by good river water quality (Nordin, 2020), big trees give good perception of human thermal comfort (Makaremi et al., 2012; Nasir et al., 2012; Yunos and Saring, 2012), and harmonious sound of birds and insects (Juffirey et al., 2015; Ratcliffe et al., 2016) contribute to the wellbeing of its users. Although HSAH has been logged for about 30 years before, and currently surrounded with urbanisation including housing and industrialisation areas, this forest has been gazetted as education forest and outdoor laboratory to educate society the fundamental in achieving SFM. FAO (2020) stressed forest education must keep pace with changing societal demands on forests and the increasing pressures on forest resources as this may also lead to concern in human health and wellbeing. Univeristi Putra Malaysia (UPM) has been given the authority to use HSAH as a school's forest. Apart from teaching and learning activities, this forest is also used for community activities to educate community with nature education as well as integration of social aspects of forests such as recreation, tourism, human health and well-being into SFM.

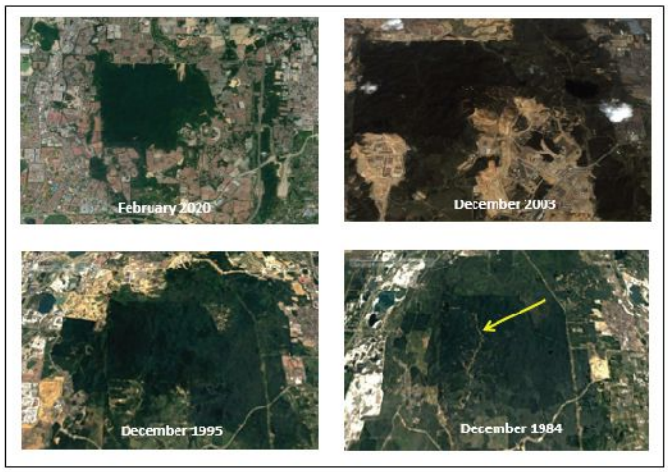

Figure 3: Changes of HSAH examined from GE imagery from 1984.

If all forest management units (FMU) are sustainably managed by conserving and preserving all the goods and services that are beneficial to human health, these benefits can be kept for the enjoyment of the future generations. Forest managers are duty-bound to ensure that all timber and non-timber forest products are used sustainably so that timber trade and the economy of forest-dependent community can be maintained for the long term. Users also have a role to play in supporting the sustainability of forest management by the wise use of forest resources without disturbing the ecosystem and biodiversity of our forests.

Conclusions

To maintain the quality of the forest ecosystem and a continual flow of benefits to human health and wellbeing, sustainability of forest management along with sustainability of forestry operations and comprehensive forest therapy research need to be tackled in collaboration with various stakeholders, which include, but not limited to, forest managers, forest concessioners, local communities, recreational users, and end users of forest products and non-timber forest products. Rapid urbanization, globalisation, digitalisation, ageing of the population as well as a sedentary and stressful modern lifestyle create challenge and/opportunity to the forestry sectors. These aspects should be taken into consideration and integrated

into forest management planning which will represent, in most cases, modification of forest management as well as improving participatory process involving various stakeholders and organisations.

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INTROPica
HIGHLIGHTS

PRESERVING NATURAL ECOSYSTEM IS ESSENTIAL TO MAINTAIN HUMAN HEALTH AND WELL-BEING

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Introduction

Within nine months, more than 1 million deaths due to the COVID-19 pandemic caused by the novel SARS-CoV-2 have been reported (https://www.worldometers.info/coronavirus/). While the earlier prediction on human population growth may reach 9 billion in the next 30 years are being attested, humans are currently facing a global pandemic that threatens the human health and population. At the time of this writing, SARS-CoV-2 had been detected in several species including tiger, lion, pig and bat (Opriessnig & Huang, 2020) but the main source of the COVID-19 outbreak remained to be determined (Yuen et al., 2020). Other viruses that have caused pandemic diseases include the Nipah virus which had been identified from flying fox, *Pteropus* spp. (Chua, 2003), and the MERS coronavirus from camel, *Camelus* sp. (Azhar et al., 2014). Consequently, it is crucial for humans to cohabit with wildlife prudently by preserving their natural habitats as well as avoiding consumption of wild meat and close contact with wild animals as a means to prevent the emergence and spread of zoonotic diseases.

Urbanisation and Human Health

Since 1950, the world has been experiencing rapid growth in urban populations from 751 million in 1950 to 4.2 billion in 2018, of which 54% are from Asia (United Nations, 2018). Following the trend of global urban population growth of 1.73%, Malaysia is experiencing an annual growth in urban population at a rate of 1.87% (United Nations, 2018). At the beginning of 2020, more than three fourths of the country's population is living in urban areas (United Nations, 2018; Ismail et al., 2018). Such expansion impose pressures on natural habitats including forests as observed in Peninsular Malaysia where its forested areas had shrunk by 14% between year 2000 and 2012 (Butler, 2013) while the urban land is expanding 1.5% annually (Schneider et al., 2015). Such changes in land cover and use often resulted in alterations to biogeochemical cycles, climate and biodiversity (Fitzherbert et al., 2008; Grimm et al., 2008).

Rapid urbanisation often shrinks the natural habitat available for wildlife, resulting in habitat loss, population decline of native species and potential introduction of non-native species (Sabrina & Nik Hanita, 2012). Intense landscaping at roadsides and in urban parks primarily for ornamental and shade purposes increases homogeneity of plants in urban areas, as non-native plants are often being planted for urban beautification (Grimm et al., 2008). Low vegetation diversity and habitat structure complexity in urban landscape could attract and support only certain species of wildlife e.g. primates (Yap et al., 2019), birds (Lim & Sodhi, 2004), bats (Lim et al., 2018), and insects (Sing et al., 2016). Although the survival of the species depends on their ability to adapt and naturalise in the modified (urbanised) environment (Lowry et al., 2012), modification to the natural habitats often impacts the survival of species adversely. For example, forested habitats in urban areas are often fragmented by roads and consequently, wildlife risks their life when crossing the roads as part of their foraging habits which often results in roadkill.

The close proximity between human and wildlife could impose risks to human health as well as resulting in human-wildlife conflicts. Monkeys have been reported creating public nuisance and fear, as well as damaging plants in the cities (Karuppannan et al., 2009; Md-Zain et al., 2009). Crows often gather and roost in big number in major urban areas causing noise pollution and concerns over health issues due to their droppings. Pathogenic Leptospira which causes the zoonotic disease Leptospirosis had been recorded in rats *(Rattus rattus)* in urban areas (Pui et al. 2017). In addition, provision of human food by wild animals such as monkeys, are commonly observed at forest edge in Malaysia. Although little is known about the adverse effects of human feeding food to the monkeys (i.e. *Macaca fascicularis)* on their diet and behaviour, the close proximity between humans and the monkeys during the feeding and petting activities could increase the risk of pathogen transmission that causes zooanthroponosis (Chong et al., 2020).

Conclusions

Malaysia is undergoing rapid urbanisation in line with the national economic goals, and urbanisation often occurs at the expanse of natural habitats. Wildlife that rely on the complex tropical forest ecosystem for their survival, provide reciprocal ecosystem services such as pollination and seed dispersal, which are beneficial to mankind. However, urbanisation reduces the forested areas and hence thinning the barrier between humans and wildlife could increase the

probability of zoonotic disease occurrence and spread. The current COVID-19 crisis could perhaps serve as a warning sign of a population bust for humans which has been growing exponentially. Preserving natural ecosystem health remains as the way to maintain the barrier between humans and wildlife and thus human health, which should be taken into consideration in land use planning.

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Photo Captions

a) Land development should consider its long-term consequences to ecosystem and human health.

b) Human-wildlife conflicts often occur in villages close to a forest.

c) Unplanned forest conversion could lead to close contact of wildlife and human increasing conflicts between them and chances of zoonosis transmission.

INTROPica
HIGHLIGHTS

FOREST HEALTH MONITORING BASED ON WORLDVIEW SATELLITE IMAGES FOR HUMAN HEALTH DEVELOPMENT AND SECURITY

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Introduction

The standard of human health is not only sufficiently assisted by family income, but it also depends on the quality of the environment. Tropical forests provide water supplies and preserve the ecosystem's role as one of the main needs of humanity to maintain life on earth. Based on spectral indices from the Worldview satellite remote sensing spectral channel, human activities on forested land can be tracked, which can reduce forest exploitation, increase its functionality, and reduce its vulnerability to losses. The canopy conductance, soil moisture, solar radiation and temperatures restrict the productivity of forests, therefore, tropical forests needs to maintain their productivity (Harris, 2004). The forest ecosystems services have been degrading due to human intervention exposing the forest to climate change. Human activities were measured by river pollution, peatland fires, smoke and haze, illegal logging and landslides recorded in some areas. The decrease of forest function has become an issue to the human being. Higher-resolution satellite images with improved spectral efficiency is a valuable tool for assessing forest health elsewhere and especially in South-East Asia (SEA).

The rapid launch of Worldview's latest satellite series is facilitated by natural and man-made fire events globally. Peatland fire in the area of SEA prompted the creation of peatland fire tragedy-related fire prediction and warning systems (GEC, 2010). Man-made forest fire accelerates land loss and exposes forests to impacts of land use change, i.e. impacts on forest edges, destruction of biodiversity, contamination of rivers and air, and many more. Worldview-3 satellite images were analysed in this article to derive indices for various forest subject application types globally. This paper illustrates the usefulness of satellite indices in addressing forestry issues, thereby opening further doors for the forestry department to use recent globally satellite images in forest management.

Drought and Peatland fire

A high mortality rate was reported during drought compared to non-drought season in Lambir Hill National Park, Sarawak, East Malaysia calculated from vegetation plot analysis (Nakagawa et al., 2000). Moreover, in 2005, 2006, 2008, and 2009, transboundary smoke haze triggered the destruction of 14 haze-related diseases (Sandifer et al., 2015). Smoke haze emissions caused by peatland fire in the Malay Peninsula was caused by forest fires. In addition, an episode of intense haze was reported at the end of 2006 (Hyer & Chew, 2010). Elsewhere, in the province of Jambi, fire allegedly occurred based on hotspots data from 2001 to 2015 (Prasetyo et al., 2016). Some forest area such as in Pasoh Forest Reserve (PFR) is located at the driest region in Peninsular Malaysia. It is very critical to monitor the forest health by measuring soil moisture indices through satellite imagery to have a bigger coverage compared to point field observation. Recent study showed that the soil moisture indices based on the high-resolution image are positively correlated with the NDVI of PFR.

Fire risk mapping was previously built based on current and inexpensive remote sensing satellite images (Pradhan et al., 2007), as a result of SEA's major fire events in 1997 and 1998. Several studies have recently selected greater satellite coverage for fire evaluation analysis elsewhere (Sheriza et al., 2010).

Worldview-3 spectral indices

The Worldview satellite was launched in 2014 to capture a 1.24 metre resolution forest surface (DigitalGlobe, 2014). Worldview-3 launched a proven suitability application for the identification of tropical forests and urban species due to its greater resolution, (Cho et al., 2015). Spectral indices are a mathematical equation developed for specific purposes from spectral channels available in satellite image, namely land cover classification, measurement of forest production, assessment of forest health and disease, estimation of soil moisture, surface temperature, water stress and calculation of soil effects of surface degradation.

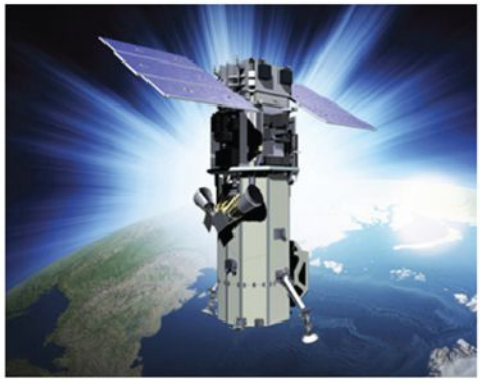

Figure1.0 Worldview-3 satellite sensor (Source: DigitalGlobe, 2020).

The additional four new bands from the previous Worldview satellite array, enhance the capability of Worldview-3 for measuring the vegetation index; (i) coastal (400-450 nm), (ii) yellow (585-625 nm), (iii) red-edge (705-145 nm) and (iv) near-infrared-2 (860-1041 nm) applied to the basic red, green and blue or RGB bands. The basic wavelengths properties are depicted in Figure 2.

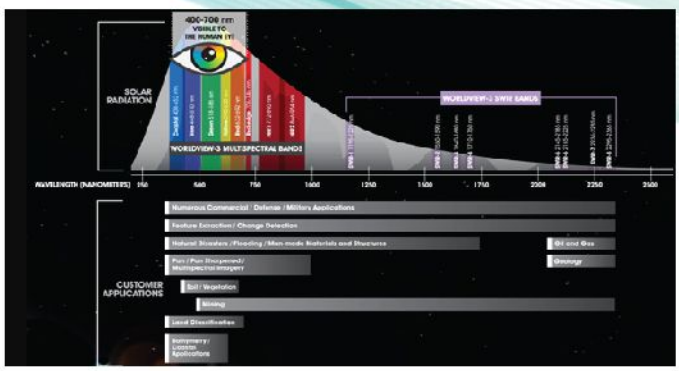

Figure 3.0 Worldview-3 satellite sensor wavelengths range which shown in nanometres(nm). The 400-700 nm is very useful for forestry application whereas for Shorwave infrared reflectance bands is suitable for water content study.

Therefore, by using red band and near-infrared bands, it is competent to measure Normalized Difference Vegetation Index (NDVI) because they are very important for the greenness component (Liu et al., 2015). The NDVI is the first vegetation index established by (Rouse et al., 1973) as a simple index measuring chlorophyll and photosynthetic

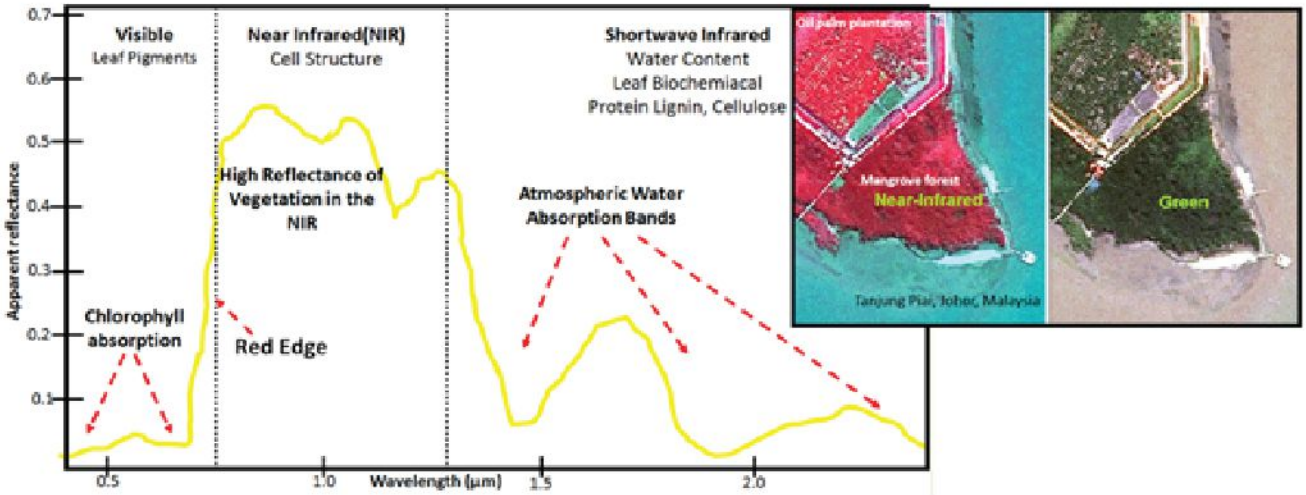

Figure 2.0 Satellite wavelengths range and mangrove forest in Tanjung Piai, Johor, Peninsular Malaysia shown in NIR and green bands colour, which shown in micrometres (µm).

sensitivity to vegetation (Nightingale et al., 2014). The NDVI result suggested the occurrence of forest loss in Palangka Raya, Indonesia during the evaluation of forest changes in 2012 (Darmawan & Sofan, 2012).

The red-edge band is also very useful in burn intensity mapping because its band is correlated with chlorophyll variations observed in a Sentinel-2A satellite (Fernández-Manso et al., 2016). For example, the study found Normalized Difference Red-Edge (NDRE) to be significantly discriminating the fire incidence in fires severity mapping. Therefore, it was found that the red-edge band performs better compared to the standard NDVI index (Mutanga et al., 2012). The red-edge band also allows pigment indices and vegetation health evaluation studies in a plantation forest due to bronze bug in South Africa *(Thaumastocoris peregrinus)* (Oumar & Mutanga, 2013). The Green Normalized Difference Vegetation Index (GNDVI), which is more susceptible to dense vegetation, is among other measures appropriate for Worldview-3. Moreover, this analysis also included the Generalized Difference Vegetation Index (GDVI), the Ratio Vegetation Index (RVI) and the Bare Soil Index (BSI) as the appropriate index for the satellite image. Table 1.0 showed complete formula for the index's calculation.

Table 1. Worldview satellite indices derived from NIR, green, blue and red-edge bands.

	Index	Formula (bands)	Source
WorldView3	NDVI	(NIR-RedT(NIR+ Red)	(Rouse et al., 1973)
	GNDVI	(NIR-Green)T(NIR+ Green)	(Gitelson et al., 1996)
	GDVI	(NIRTRed-1)T(NIRTRed+1)	(Wu, 2014)
	NDRE	(NIR-Red Edge)/(NIR+Red Edge)	(Fitzgerald et al., 2010)
	RVI	NIR/Red	(Jordan, 1969)
	BSI	(Red+Blue)-Green / (Red+Blue)+Green	(Azizi et al., 2008)

Conclusions

The paper highlighted the significance of the spectral application of Worldview-3 satellites in monitoring forestry issues around SEA and globally. This article suggests that indices for spatial distribution and temporal distribution can be applied because they are useful in mapping risky areas of forest. It is possible to choose an affordable satellite to map potential land degradation for future management planning. Most of these indices have been widely used in different forest types regionally.

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INTROPica
HIGHLIGHTS

ASSESSING FOREST ATTRIBUTES USING CHOICE EXPERIMENT METHOD

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Introduction

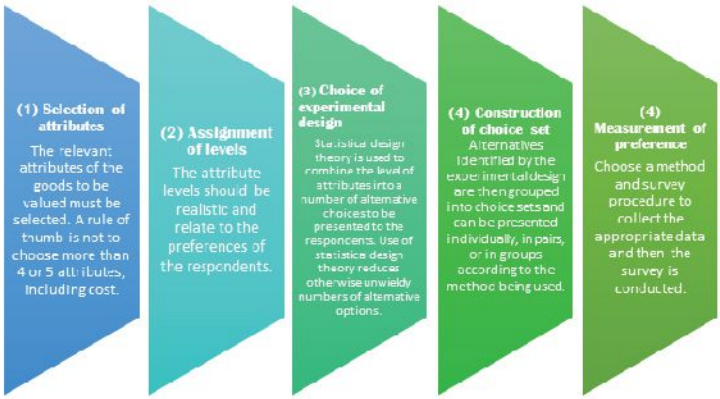
Forests host a large population of biodiversity that play a crucial role in global climate regulation. Besides that, it represents a foundation for the provision of ecosystem services such as clean air and water, valuable timber, animal and plant resources of with high commercial and cultural value. However, forests are facing great pressure as a result of increasing human exploitation. Diverse forest functions, such as recreational use or habitat conservation, require sustainable forest management. Successfully achieving sustainable forest management will provide numerous benefits to the people and to the nature.

All the benefits provided by the forest do not generally attract a price, they are often referred to as non-market values. These values can derive by using the economic evaluation techniques. Given the extensive multiple demands and trade-offs between different goods and services supplied by forests and increasing demand from the public for the use of forest services, economic valuation can support policy making, by finding options that includes public's preferences. The purpose of economic analysis is to warrant ideal use of the forest resources available to society that will maximise people's well-being. In addition, the analysis can provide guideline to the policy maker in designing optimal forest management strategy. One of the popular methods in quantifying the value of forest resources in monetary value is the Choice Experiment (CE) method. This method has been widely applied to understand public preferences for forest management with the purpose of achieving good sustainable practice of forest resources.

Choice Experiment (CE) Method

CE method is based on a hypothetical market situation, whereby respondents are presented with a series of alternatives described by different attributes-levels combinations. Then, they are required to choose their most preferred alternatives from the series of alternative combinations given in the choice cards.

Designing CE study involves few steps:



Adapted from: Pearce and Ozdemiroglu (2002)

The advantages of CE compared to the other economic valuation approaches are as follows (Hanley et al., 2001):

- CE is mostly suitable to deal with circumstances where changes in particular goods or services are multidimensional and the trade-off between them is of particular interest.
- Respondents in a CE have several chances to express their preferences for the goods being valued over a range of payment amounts from a number of alternatives.
- CE commonly avoids asking respondents about their willingness to pay (WTP) values directly. The WTP amount that respondents choose comes together with other combination of attributes in the alternative presented.

Example of CE studies on Forest

A study by Müller et al., (2020) apply CE to elicit the population's WTP for specific forest management alternatives across Switzerland. The results reveal that the population prefers forests, which are neither dominated by coniferous nor by deciduous trees but show a balanced mixture of both. Besides, there is significant preference for permanent forests instead of single-age-cohort management.

Description of CE attributes and levels.

Attributes/Labels	Levels
Program orientation (ASC)	Habitat Recreation Status quo
Tree species (TS)	Deciduous trees dominate Coniferous trees dominate About the same number of coniferous and deciduous trees
Forest structures (FS)	No pattern visible (permanent forest) Patterns partially visible (mixture of permanent and cutting forests) Patterns clearly visible (cutting forest)
Wood utilization (WU)	Interventions not visible Interventions occasionally visible Interventions largely visible
Area with additional measures (AM)	Area extended by 5% Area extended by 10% Area extended by 20%
Monetary contribution (MC) Households: Amount to be paid annually per household Foresters: Amount to be received annually per ha	10; 25; 50; 75; 100 or 125 USD[4]

Figure 1: Description of CE attributes and levels

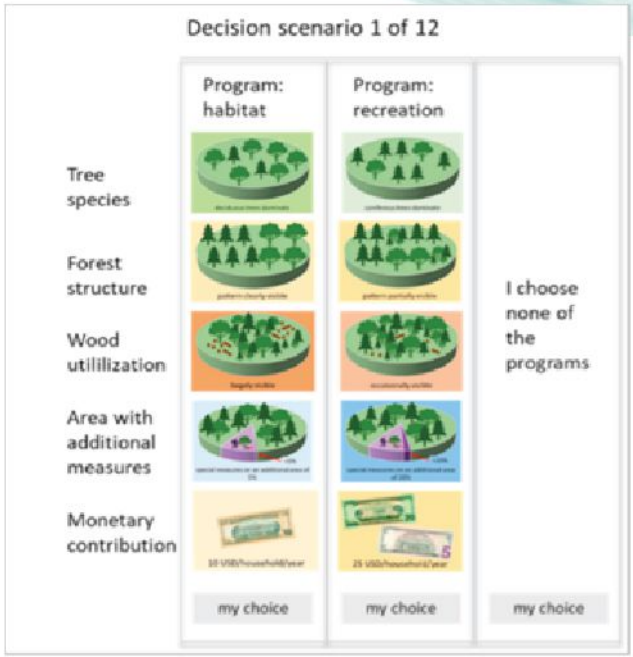


Figure 2: Example of CE choice cards

Source: Müller, A., Olschewski, R., Unterberger, C., & Knoke, T. (2020). The valuation of forest ecosystem services as a tool for management planning – A choice experiment. Journal of Environmental Management, 271, 111008.

A study by Weller & Elsasser (2018) used CE method to elicit coefficients and WTP values for eight structural characteristics of forests for 2932 respondents from a Germany-wide population sample. Results reveals that postive WTP values exist for increasing the share of forests, increasing the harvest age of forests, increasing biodiversity and maintaining some unused forest areas. Large negative WTP values are found for decreasing the share of forests, changing the amount of coniferous trees to 70%, and increasing the amount of trees from other countries.

Attributes and levels used in the CE.

Names of fixed attributes in survey (in Samples 1 and 2)	Name in models	Levels (status quo 'as today')
Share of forests	ShareForest_m10	Decrease by 10%
	ShareForest_p10	Increase by 10%
Field and forest size	FieldSize_half	Half the current size
	FieldSize_double	Twice the current size
Financial contribution to landscape fund per year	Price	0, 10, 25, 50, 80, 110, 160 €
Flexible attributes in Sample 1		
Understorey in forests	Understorey_half	Half as much as today
	Understorey_double	Twice as much as today
Share of coniferous trees	Conifers_30	30% of forest area
	Conifers_70	70% of forest area
Harvest age of forests	HarvestAge_20	Delay harvest by 20 years
	HarvestAge_30	Delay harvest by 30 years
Flexible attributes in Sample 2		
Biodiversity in forests	Biodiversity_85	Slight increase (to 85 points)
	Biodiversity_105	Considerable increase (to 105 pts.)
Unused forest areas	UnusedAreas_0	0% of forest area
	UnusedAreas_10	10% of forest area
Share of tree species from other countries	ForeignSpecies_half	Half as much as today
	ForeignSpecies_double	Twice as much as today

Note: All attributes had the status quo level 'as today', changes were valued from this base level.

Figure 3: Attributes and levels used in the CE

If only the following options were available for the future development of the landscape within a radius of up to 15 kilometres around your place of residence, which one would you choose?
If you live in a large city, please consider the surrounding area of the city.

	Landscape A	Landscape B	Landscape C
Share of forests	Decrease by 10%	Increase by 10%	As today
Field and forest size	Half the current size	Twice the current size	As today
Understorey in forests	As today	Twice as much	As today
Share of coniferous trees	30%	70%	As today
Harvest age of forests	Delay harvest by 20 years	Delay harvest by 30 years	As today
Financial contribution to landscape fund per year	25 €	80 €	0 €
I choose			

Figure 4: Attributes and levels used in the CE

Weller, P., & Elsasser, P. (2019). Preferences for forest structural attributes in Germany – Evidence from a choice experiment. Forest Policy and Economics, 93, 1-9.

Another study by Taváreza and Elbakidze (2019) use CE method to examine residents' preferences and WTP for different recreation enhancement projects in an urban forest in Puerto Rico. Results reveal that residents are willing to pay $29, $15, $26 and $39 for improved trails, an event stage, stands with binoculars and a community garden. The results also suggest that projects aimed at increasing urban forest-based recreation opportunities maybe justified conditional on respective project costs.

Attributes and levels for the choice experiment.

Attributes	Description	Levels
Trails	Managing trails for hiking to enable elderly and people with physical difficulties to walk or move within the forest.	Impoved trails Current trails
Stage for activities	Construction a small stage in a designated space within the forest for different cultural activities, such as small concerts, educational workshops, yoga and meditation classes.	Available Not available
Stand with binoculars	installing two stnds with binoculars within the forest and some management to support bird watching.	Stand with binoculars No stands or binoculars
Community garden	Designating space exclusively for community gardening within the forest. The community garden can be used foreducation purpose and to generate income that be reinvested in the forest.	Development of a community garden No community garden
Cost	Household cost of recreation enhancements in each project scenario. Any money paid toward recreation must beconsidered spent money that cannot be used for other purposes	$0 $10 $25 $50 $100

Figure 5: The attributes and levels used in CE

Recreation	Option A	Option B
Trails	Current trails	Improved trials
Stage for activities	Available	Not available
Stands with binoculars	Stands with binoculars	No stands or binoculars
Community garden	No Community garden	Development of a community garden
Cost	$25.00	$50.00
	Option C None: I would not choose either of these options	

Figure 6: Example of choice set used in the study

Source: Tavárez, H., & Elbakidze, L. (2019). Valuing recreational enhancements in the San Patricio Urban Forest of Puerto Rico: A choice experiment approach. Forest Policy and Economics,109(C).

Conclusions

Forest resources are invaluable environmental assests that we must maintain and conserve. The multifunctional of forests such as protective functions (e.g. water, soil, infrastructure), productive functions (e.g. timber, raw materials), and recreational functions give pressure to the forest ecosystem. The numerous demands on forests resources in a rapidly progressing economic, social, and political environment indeed required a high level of forest management operation. Therefore, it is important to assess today's needs and values and to understand the economic utility and social significance of forests to achieve optimal management strategies of this invaluable resources.

INTROPica
HIGHLIGHTS

LINKING WOOD-BASED BUSINESSES TO SOCIAL RESPONSIBILITY

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Introduction

Corporate social responsibility (CSR) concept is well-known and mature. It carries the value of sustainable development in the era of economic globalisation. Sustainable development is achieved when the wealth is well distributed among the society and the wellbeing of the society is taken care of. The World Business Council for Sustainable Development (1999) defines CSR as "...operating a business enterprise in a manner that consistently meets or exceeds the ethical, legal, commercial, and public expectations society has of business". Based on this definition, any businesses that engage in CSR need to operate and meet society's expectation, especially on community wellbeing.

The concept of CSR was developed formally in the 1950s. Bowen's (1953) initial definition of the social responsibilities of businessmen at that time referred to the obligations of businessmen to pursue those policies, to make those decisions, or to follow those lines of action which are desirable in terms of the objectives and values of our society. Then Frederick (1960) defined social responsibilities of a business should oversee the operation of an economic system that fulfils the expectations of the public. This means in turn that the economy's means of production should be employed in such a way that the production and distribution should enhance total socio-economic welfare.

Johnson (1971) defined social responsibility in business is the pursuit of socio-economic goals through the elaboration of social norms in prescribed business roles; or, to put it more simply, business takes place within a socio-cultural system that outlines through norms and business roles particular ways of responding to particular situations and sets out in some detail the prescribed ways of conducting business affairs. In 1980, Jones discussed the definition of CSR as *the notion that corporations have an obligation to constituent groups in society other than stockholders and beyond that prescribed by law and union contract.*

Caroll (1991) highlighted four kinds of social responsibilities which form the total CSR: economic, legal, ethical and philanthropic functions. The four kinds of social responsibilities depicted as a pyramid, all of which have always been implemented to some extent, but in recent years ethical and philanthropic functions gained interests significantly. More specifically, economic function implies a business to provide goods and services to the society; legal function requires a business to comply with the laws and regulations promulgated by the government at all levels as the ground rules to operate; ethical function emphasizes a business should embody the standards, norms, expectations that reflect a concern of consumers, employees, shareholders, and the community; and lastly, the philanthropic function requires corporate actions that are in response to society's expectation that businesses be good corporate citizens (Caroll, 1991).

Wood-based product manufacturing industries are highly relevant to the four kinds of CSR due to the nature of the business which is natural resource-driven but obliged to conserve the environment at the same time. The industries are often being linked to causing damages to forest ecosystems. Although many logging areas are categorised as production forests that are meant for timber harvesting, some NGOs are constantly mistaken the fact. These organisations overlook the stringent rules from various certification bodies which require the wood-based manufacturers to conform to the production guidelines and certification to be able to market their products responsibly.

This wood-based product manufacturing industries continue to be a significant contributor to Malaysia's economy. Malaysia is ranked as the eighth largest exporter of furniture in the world, 80%of which is wood based. Its main overseas markets are the USA, EU, Japan, and Australia. The industry comprises over 3,500 mostly locally owned companies that are concentrated in Johor, Selangor, and Pulau Pinang . Furthermore, there are 20 public listed companies in Bursa Malaysia that are under this sector. These companies are currently operating at various scales.

Udayasankar (2008) linked the idea of CSR to the size of a business, where a smaller scale of operations faced resource access constraints leading to lower visibility and resulted in low participation in CSR initiatives. It is a long-standing debate on the effects of business size on CSR. This article highlighted CSR participation among the wood-based businesses and analysed the level of participation based on their business size. Our hypothesis is business size is linked with CSR activities participation.

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[3]Frederick, W. C. (1960). The growing concern over business responsibility. California Management Review,2, 54-61
[4]Johnson, H. L. (1971). Business in contemporary society: Framework and issues. Belmont, CA: Wadsworth.
[5]Carroll, A. B. (1991, July/August). The pyramid of corporate social responsibility: Toward the moral management of organizational stakeholders. Business Horizons,34, 39-48.

Methodology

We collected 20 public listed wood and wood products companies' data on their CSR activities and their annual revenues for 2019. The data were obtained from their annual report year 2017 to 2019 and their websites. The data were ranked according to their annual revenue for the year 2019 and CSR activities were recorded according to the companies. The revenue was classified into three manufacturing business size; large, mid-tier, and small-medium enterprises (SMEs). Since there is no formal definition for a large company in Malaysia, it is perceived as following the next category after mid-tier, which generated annual revenue of more than RM500 million. Mid-tier company is defined as a business that had annual revenue between RM50 million to RM 500 million (MATRADE, 2011) . Small-medium enterprise (SME) is defined as a business that has a sale turnover of less than RM50 million (SME Bank, 2017)[9] .

Results and Discussion

Among the public listed companies in the wood-based sector, 10 out of 20 companies (50%) demonstrated that they practised CSR activities with the community either in their annual report or websites. Out of nine companies, three (75%) are in the large company's category, three (43%) are mid-tier companies and four (44%) are the small-medium enterprises. Table 1.0 shows the public listed company in the Malaysian wood-based sector, their annual revenues and the extent of their CSR activities. The companies are ranked based on their revenue and classified according to their business size with their colour coded. The pink colour represents the large-scale business, the blue colour represents mid-tier, and beige colour represents small-medium businesses.

Table 1.0: Wood-based public listed companies and their CSR activities engagement in Malaysia

Company	Revenue 2019 (RM Million)	Example of social activities engaged (2017-2019)	Business size
EVERGREEN FIBREBOARD BERHAD KPS CONSORTIUM BERHAD	967.2	• Raised fund for the charity.	Large
KPS CONSORTIUM BERHAD	954.5	Data not available	
DOMINANT ENTERPRISE BERHAD	729.8	• Established an Education Award. • WeCare charity club was established, to take proactive steps to help the needy and less fortunate. • Provided appropriate trainings and educational sponsorships for employees. • Educate the public about the benefits of using environmentally-friendly products and constantly promoting them in the market.	
WTK HOLDINGS BERHAD	589.7	• Encouraged employees to volunteer and actively participate in community outreach activities. • Donation for environmental awareness and education projects	
MIECO CHIPBOARD BERHAD	427.3	Data not available	Mid-Tier
HEVEABOARD BERHAD	419.1		
SUBUR TIASA HOLDINGS BERHAD	314.6	• Blood donation drive • Sponsorship of plywood to public facilities, i.e. schools, the religious centre	

[6] https://www.mida.gov.my/home/wood-&-wood-products-and-furniture-&-fixtures/posts/
[7] Udayasankar Krishna (2008). Corporate Social Responsibilityand Firm Size. Journal of Business Ethics, 83, 167-175.
[8] http://www.mtcdp.my/mtcdp-overview/
[9] https://www.smebank.com.my/en/about-us/sme-definition

		• Sponsorship of furniture items to public facilities, i.e. clinics, community centre • Contributed to the construction of roads, bridges and jetties • Improved cell phone and internet connectivity to most sitest.	
MINHO (M) BERHAD	258.2	Data not available	
FOCUS LUMBER BERHAD	142.4	• Provided financial supports to various associations, social events and societies	
EKSONS CORPORATION BERHAD	67.3	Data not available	
GOLDEN PHAROS BERHAD	57.5	• Sponsorship for the construction of a school • Construction of public toilets, surau, and other public facilities • Endowment to students from various schools • Construction of observation deck • Organised festivities for the community • Organised recreational activities • Sponsorship and donation to various NGOs and charity organisations	
CYMAO HOLDINGS BERHAD	46.3	Data not available	SME
LEWEKO RESOURCES BERHAD	38.8		
PRICEWORTH INTERNATIONAL BERHAD	31.1	• Built and continuously maintaining steel and concrete bridges • Employment opportunity and necessary training to the local villagers • 4,101 hectares have been designated as community forest zone	
TIMBERWELL BERHAD	28.3	• Contributed plywood for construction of public facilities, i.e. churches, schools • Monetary contribution for schools, and community events • Contributed to bridges and roads repair	
WOODLANDOR HOLDINGS BHD	24.8	• Contributions and donations were made to schools, temples and charitable organizations to assist in their fund-raising • Donations to numerous NGOs	
MENTIGA CORPORATION BERHAD	15.2	• Education Segment • Local Societies	
BTM RESOURCES BERHAD	9.4		
ANZO HOLDINGS BERHAD	6.2		
NWP HOLDINGS BERHAD	6.9		

Results in Table 1.0 showed that the business size was linked with the number and type of CSR activities participated. As discussed by Udayasankar (2008), business size can influence business strategic motivation, thereby having a positive effect on CSR participation (Adams and Hardwick,1998 ; McElroy and Siegfred, 1985). As larger firms tend to have a bigger social impact, given the scale of their activities (Cowen et al., 1987), it is deemed equitable that the responsibility to be socially responsible also falls on them, rather than on small firms.

As is illustrated in Table 1.0, the CSR participation by the large companies focused on establishing charity organisations and awards, training and educational sponsorships, and environmental-driven awareness projects. Compared to mid-tier and small-medium companies, their CSR activities focused on donations, sponsorships, recreation projects, small construction and repair works in the community areas.

This article proved the idea that larger firms tend to be more visible, and hence are likely to be more socially responsive whereas smaller firms may face fewer pressures, or gain little recognition from CSR activities, given their comparatively lower visibility. However, the results indicated that the smaller firms engaged communities living closer to them in more short-term development projects, such as maintenance of bridges, repair works on public facilities, and hosting festival activities.

The impact of business size on CSR participation is also related to the accessibility to resources (Brammer and Millington, 2006). Larger firms are associated with greater resources, and this was found to significantly affect their CSR commitment (Johnson and Greening, 1999). Smaller firms often have constrained or limited resources, which may make it unviable for them to engage in CSR initiatives. However, the data regarding the amount (RM) spent on CSR activities for the above companies were not available. It shows the low level of disclosures among the businesses in reporting the amount spent on CSR.

Conclusions

The adoption of CSR by the public listed companies in the wood-based industry is high for large companies whereas it is moderate for mid-tier, small and medium companies. This article showed the moderate to high level of commitment was given by the Malaysian wood-based companies in ensuring the well-being of the community by linking their business and fulfilling their CSR.

[10] Adams, M. and P. Hardwick: 1998, 'An Analysis of Corporate Donations: United Kingdom Evidence', Journal of Management Studies35, 641–654
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FOREST: HUMAN HEALTH AND WELLBEING







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