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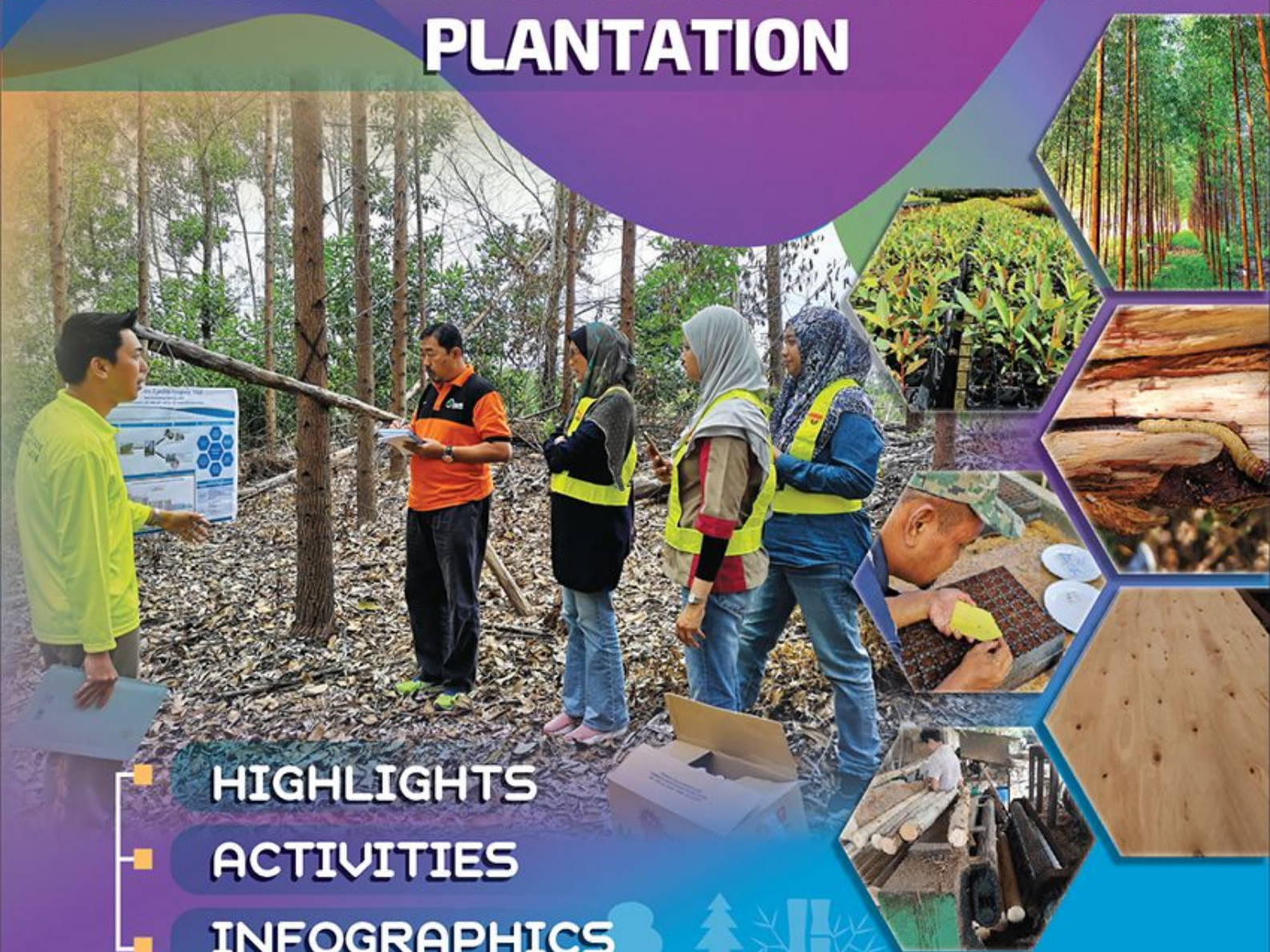
ECOSYSTEM SERVICES IN FOREST PLANTATION



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The 18th edition of INTROPica is published by the Institute of Tropical Forestry and Forest Products (INTROP), one of the Higher Institution Centre of Excellence for Research (HICoE) in Malaysia. INTROP is leading in wood and bio fibre research with a multidisciplinary focus. INTROPica is contributing to the research and academia community by communicating INTROP's latest research work.

The theme for this edition is "Ecosystem services in forest plantation", emphasizes on forest plantations development, ecosystems, and future. Forest plantations program aimed to manage the forest resources in Malaysia sustainably. It began in 1980s under Forestry Department of Peninsular Malaysia (JPSM).

In this issue, there are six articles giving various perspectives on the forest plantations. Planted timber product technology and opportunities, wildlife ecosystems in forest plantations, markets and trading of timber products, microclimate and forest plantation fire, and socio-economic aspects of forest plantations, are among the topics discussed in this issue. These articles featured the recent discussion regarding the topic.

Researchers and academia who has keen interest in forest plantations would find the discussion in this edition insightful.

Your sincerely

The Editors

INTROPica
HIGHLIGHTS

PLANTED TIMBER- PROPERTIES, TECHNOLOGY AND OPPORTUNITIES

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FOREST PLANTATION PROGRAMME IN THE EARLY 80'S

Forest plantations have long been recognized as an essential part of the strategic development plan for the suitable management of forest resources in Malaysia. This strategy dates back to the beginning of the century when efforts were made to test out both indigenous and exotic species in the country. In early 80's, the Forestry Department of Peninsular Malaysia (JPSM) had embarked on planting general utility timbers under the 'Compensatory Plantation Project' covering 188,200 ha based on a 15-year rotation. Due to difficulty in procuring planting material, the majority of the areas were planted with mainly *Acacia mangium*. Unfortunately, its growth has remained below expectations, and many of the trees appeared to be susceptible to heart rot damage in some sites (Hashim et al. 1990), along with marginal performance for sawlog production (Weinland and Zuhaidi 1990).

ESTABLISHMENT OF INDUSTRIAL-DRIVEN FOREST PLANTATION

In 2005 the Ministry of Plantation Industries and Commodities (MPIC) established a large- scale forest plantations programme to alleviate the pressure on the country's natural forests. The target is to plant 25,000 ha of forest plantations per year for 15 years, or a total of 375,000 ha of forest plantations by 2020. Out of the nine selected species, two major species related are Rubberwood (Timber Latex Clone) and Acacia spp. (mangium /hybrid). Other additional fast growing timber species recommended are Tectona grandis (Teak); *Azadirachta excelsa* (Sentang); *Khaya* spp. (*Khaya ivorensis/Khaya senegalensis*), *Neolamarckia cadamba* (Kelempayan/Laran); *Paraserianthes falcataria* (Batai), *Octomeles sumatrana* (Binuang) and Bamboo (five selected commercial bamboo species). Figure 1 presents the description of these species.

PROPERTIES OF PLANTED TIMBERS

Generally, planted forests yield relatively more wood at lower cost than natural forest, the natural forest provides more valuable environmental services such as climate moderation and biodiversity. Nevertheless, the high growth rate and yield of planted forests were also offset by low wood quality and price, while manpower constraint was caused by high dependence on imported labour. While solid timbers from natural forests can be used for specialty products due to its special appearance, decorative value or technical specifications, planted timbers can be converted into laminated products, plywood or other engineered products such as laminated veneer lumber (LVL), cross laminated lumber (CLT) where appearance is of less importance. The choice of the products depends on the available technology, capital investment, logistics and the properties of the timbers. Table 1 compares some properties of planted timbers with other commercial timber species.

Figure 1. List of species and general information under the Forest Plantation Programme, MTIB. (extracted from JPSM, 2017).

Table 1. Comparative strength properties of planted timber

Species	Air-dry Density (kg/m³)	Static bending (MPa)		Compression // to grain (MPa)	Shear strength // to grain (MPa)
		MOE	MOR		
A.mangium[1,4]	260-580	12310	78.1	34.0	9.7
Rubberwood	400-750	9240	60	32.3	9.5
Sentang[5]	482-648	6770	60	31	
Khaya[3]	580-650	8700-10800	71-126	37-48	8-12
Teak[3]	610-750	8600-13400	85-106	43-72	8-15
Batai[1,3]	220-430	6890	48	26.5	6.5
Kelampayan[1] Laran[5]	370-465	7730	50	37	15
Binuang[4]	**270-465**	**6700**	**49**	**32**	**5.4**
		COMMERCIAL TIMBERS			
Pinus radiata[2,6]	500	10000	81	37	12
Yellow Poplar[7]	380	8340	38.6	38	5.5
E. pellita[3]	715	13000	63.2	-	-
Sesendok[1,3]	305-655	8530	39	20.8	5.4
Kedondong[1]	460-760	12100-12900	81	43.1-43.7	10.9-11.8

Source: [1] C.C. Lim et al. (2016); [2] NorOshiaee et al. (2014); [3] NorOshiaee et al. (2013); [4] Mateob (2019); [5] Balleres et al. (2008); [6] Moya' & F Munoz 2010; [7] Geem (1992)

▶ PROCESS TECHNOLOGY

Traditional processing approaches have not been either to accommodate small diameter logs or to create profitable production due to low product recovery. Hence alternative processing approaches are necessary to enable the efficient recovery of wood from this source in the form that is usable for high-value product manufacturing. For instance, the use of spindleless veneering technology was able to produce good quality and high yield veneers from small diameter logs compared to the traditional rotary peeled veneers. To ensure efficient use of planted timbers, the right technology to produce suitable and new products with acceptable global quality should be used (Figure 2). Technology can also shift the industry from labour-intensive sector to automated manufacturing. The industry players must align themselves to the external changes and must be ready to adopt new ways of doing business. The beneficiaries of timber from plantation forests will not only be the obvious downstream woodworking mills that produce indoor and outdoor furniture, but also mills that manufacture mouldings, doors and flooring, as well as, engineered wood products.

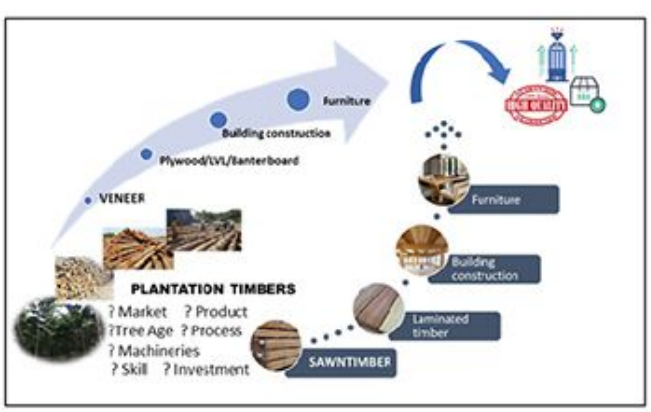

Figure 2. Product-Technological pathways for planted timbers

▶ OPPORTUNITIES

According to MTIB, Malaysia has over 4,000 mills comprising furniture, sawmills, mouldings, plywood, veneer, wood chip, kiln drying, builder's joinery carpentry and medium density fibreboard. About 83% of these mills are located in Peninsular Malaysia and 17% in both Sabah and Sarawak (MTIB, 2018) mainly using timbers from natural forest except for rubberwood, which is the major wood raw material for furniture, particleboard and medium density fibreboard. Conversely, the use of *A.mangium* in furniture is declining whilst both *Eucalyptus spp.* and batai are gaining interest from the local manufacturers particularly those of plywood and lamination sectors.

Investments on R&D in developing methods to use juvenile hardwood timbers, specifically for the eight plantation species under the Malaysian Forest Plantation programme is crucial to ensure maximum value can be benefited from the investment. Fundamental studies such as wood quality, strength, dimensional stability, sawing, drying, gluing and finishing of these timbers are of prime importance in providing guidelines for the industries when making decisions on the end product. Concurrently, investment should be made in identification of marketable opportunities for such products. At the same time, efforts towards 'zero waste' should be encouraged by converting the wood wastes into biorefinery and power generation.

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INTROPica
HIGHLIGHTS

CAN FOREST PLANTATIONS SUPPORT TROPICAL WILDLIFE SPECIES?

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▶ INTRODUCTION

The establishment of forest plantations in Malaysia can be traced back as early as 1930s and 1970s for West and East Malaysia, respectively. However, it is only about 15 years ago that efforts to establish large-scale commercial forest plantations in Malaysia have been commenced through the planting of fast-growing species comprising both native and non-native trees. Eucalypts (*Eucalyptus* spp.), Mangium (*Acacia mangium*), Kelampayan (*Neolamarckia cadamba*), Teak (*Tectona grandis*), Sentang (*Azadirachta excelsa*) and Binuang (*Octomeles sumatrana*) are among the species that have been planted in the country. Such initiatives are made as a long-term strategy to ensure continuous supply of timber for the downstream industry as well as reduce the land use pressure on natural forests. However, it is not fully understood the effects of forest plantations to wildlife especially those that strictly rely on forest habitats for their survival.

▶ WILDLIFE IN FOREST PLANTATIONS

In view of the difference in terms of habitat structure and floristic species composition, as compared to natural forest, it is expected that some wildlife species may able to thrive in forest plantations but not all (Barlow et al., 2007; Intachat et al., 1999; Scholten, 2013; Zanzini et al., 2017). Similar to monoculture agricultural crops, forest plantations also suffer damage from invertebrates that adapt well to such a habitat. This includes various species of wood borers, leaf-eating beetles, gall wasps, termites and psyllids (Schabel et al., 1999). Kelampayan and *Eucalyptus* plantations have often been infested by wood borers which result in wood quality degradation and a loss in timber value (Nair, 2001). It is reported in a study on Kelampayan that about 70% of wood borer attacks had occurred in major forest plantations in Sarawak (Chai et al., 2010). Other than pest species, comparison of four plantations planted with indigenous and non-native species in Sabah and Peninsular Malaysia found higher diversity of geometrid moths in areas planted with indigenous species (Intachat et al., 1999).

In the case of vertebrates, wildlife composition in the forest plantations has also been shown to be influenced by both local and landscape factors (Duff et al., 1984; Stuebing & Gasis, 1989; Styring et al., 2011). In Sabah, besides scansorial small mammals such as Whitehead's Spiny Rat (Maxomys whiteheadi), Common Treeshrew (Tupaia glis) and Large Treeshrew (Tupaia tana) (Stuebing & Gasis, 1989), terrestrial vertebrates including deer, civets, pig (Sus barbatus) and Leopard Cat (Felix bengalensis) have been found to be abundant in non-native tree plantations especially those located close to a natural forest (Duff et al., 1984). In the Mangium plantations in Sabah, the diversity of birds was also found to increase with the age of the plantations, although such results were only observed for the small common species, not the large specialized ones (Styring et al., 2011). Elsewhere, similar studies carried out in Brazil found that both mammal (Zanzini et al., 2017) and bird (Scholten, 2013) species richness were higher in the natural forests as compared to Eucalyptus plantations, albeit the presence of arboreal species such as Southern Brown Howler (*Alouatta guariba*), Black-fronted Titi (*Callicebus nigrifrons*) and Black-tufted Marmoset (*Callithrix penicillata*) was more noticeable in the latter (Zanzini et al., 2017).

▶ CONCLUSION

In conclusion, past studies in the tropics have shown that factors, e.g. tree species planted, the associated habitat structure as well as the distance of a plantation to natural forest influenced wildlife composition in forest plantations. Different taxa tend to respond differently to the condition of the plantations. Rare and specialised forest species may not able to persist in such landscape and their response to forest plantation development in the tropics deserves further investigation. Even forest plantations have a great potential to support future demand for biomaterials, increasing concerns over their role in biodiversity conservation (Sheldon & Styring, 2011) should not be overlooked. Nonetheless, it is expected that forest plantations may serve as suboptimal habitats for certain wildlife species. Planting of mixed species especially indigenous trees is likely to be beneficial to certain fauna species that are able to adapt to the habitat created through such planting system as compared to a monoculture environment.

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FIGURE CAPTION:

Figure 1: Common bird species such as the Zebra Dove (*Geopelia striata*) seems to do well in young forest plantations

Figure 2: The response of primate species such as the Long-tailed Macaque (*Macaca fascicularis*) to the establishment of forest plantations awaits further research.

Figure 3: The Oriental Garden Lizard (Calotes versicolor) can be commonly bserved at the edge of forest plantations

INTROPica
HIGHLIGHTS

MEETING GROWING DEMAND FOR WOOD-BASED PRODUCTS: THE ROLE OF FOREST PLANTATION IN MALAYSIA

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INTRODUCTION

Forest plantation has been regarded as a means to meet the deficit in timber supply from natural forests for wood-based processing industries. This article presents the role of forest plantation in Malaysia in the light of meeting the growing demand for wood-based products. In overall, this article is presented in four sections. The first section presents the status of natural forest resource conditions for timber production. The second section provides an overview of production and global demand for the Malaysian wood-based products market. The third section discusses the development of forest plantation in Malaysia and its role in supplementing raw materials for the wood-based processing industry. The final section presents the conclusion of this article.

STATUS OF NATURAL FOREST AVAILABILITY AND LOG PRODUCTION IN MALAYSIA

As of 2016, the total land area in Malaysia is 32.9 million ha, of which 18.24 million ha or 55.4% was under forest cover (DOSM, 2019). Of these forest land areas, Peninsular Malaysia, Sabah and Sarawak cover about 5.77 million ha, 4.56 million ha and 7.91 million ha of area, respectively. The supply of logs for the wood-based industry is usually derived from several land areas namely Permanent Reserved Forests (PRFs) covering approximately 14.55 million ha and state land forests and alienated land with an estimated forest area of 4.74 million ha. While logging and land clearance or conversion is permitted on most of state land forest and alienated land, approximately 11.32 million ha of PRFs have been zoned for timber production and the remaining 3.182 million ha being gazetted as protection, amenity or research and education forests (DOSM 2016).

Figure 1 shows the trend of forest area and logs production in Malaysia from 1990 to 2016. Over the past 26-years period, forest area in Malaysia has declined from 19.62 million ha in 1990 to 18.24 million ha in 2016, a decrease of 7%. This loss of forest areas is a result of the conversion of forest lands to permanent non-forest uses to meet the demand of the growing population for agriculture, settlements, and infrastructure (FAO, 2016).

While there has been a slight decrease (7%) in the forest area in the period 1990-2016, log production from the PRFs indicated a progressive decline over the 26 years (Figure 1). The total production of logs from natural forests in Malaysia had declined by 65% from 40.10 m3 in 1990 to 13.94 m3 in 2016. Although the gradual reduction of forest areas plays a part in the declining trend of log production, several other reasons also contribute to the decreasing trend. Firstly, is related to the annual allowable cut (AAC) allocated for the production forests within the PFRs. As can be seen in Table 1, the AAC has been reduced every five years following the Malaysian Plan periods, especially in Peninsular Malaysia in compliance with sustainable management practices. Secondly, most of the PRFs are logged-over forest and although the forests are capable of producing an economic harvest, however, they are less productive, poorly stocked and contain fewer commercial species after being continuously harvested (Shukri, 2008). In this regard, there is a need for concern on the future supply of logs for the local timber industry given the declining trend of traditional timber resources.

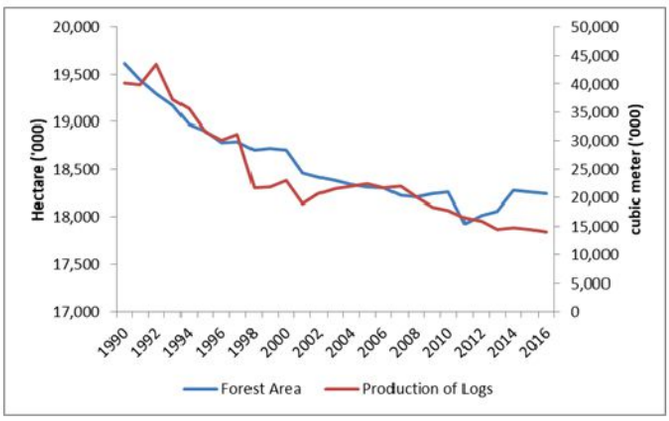

Figure 1: Forested area and log production in Malaysia from 1990 to 2016. Source: FAOstats-Forestry database

Table 1: Annual allowable cut in permanent reserved forests (hectare/year)

Malaysia Plan (MP)	Peninsular Malaysia	Sabah	Sarawak	Total
7th MP (1996-2000)	46,000	60,000	170,000	276,000
8th MP (2001-2005)	42,870	60,000	170,000	272,870
9th MP (2006-2010)	36,940	60,000	170,000	266,940
10th MP (2011-2015)	39,833	60,000	155,000	254,833
11th MP (2016-2020)	41,888	50,000	155,000	246,888

▶ PRODUCTION AND TRADE OF MAJOR FOREST PRODUCTS

Table 1 gives an overview of the production and trade of major forest products in Malaysia. Over the 26 years (1990-2016), wood-based panel production especially particleboard, oriented strand board (OSB) and medium-density fiberboard (MDF) recorded impressive growth from a mere 0.110 million m3 in 1990 to 1.76 million m3 in 2016. Trade of particleboard, OSB, and MDF also recorded an increasing trend from 1990 to 2016. These increasing trends in production and trade are due to the Malaysian policy supports for downstream processing and value-added production such as furniture through the log export ban from natural forests especially in Peninsular Malaysia which started in 1987.

As expected, the production of industrial roundwood (wood in the rough form such as sawlogs and veneer logs, pulpwood and other industrial roundwood) fall by 66% from 41.26 billion m3 in 1990 to 13.86 million m3 in 2016 (Table 2). This downward trend was also observed for sawnwood production of which in 2016 recorded production of 3.42 million m3 compared to 8.85 million m3 in 1990, a decrease of 61%. Similarly, export volume for industrial roundwood and sawnwood declined by 84% and 63%, respectively during the 26 years. The deficit in roundwood and sawnwood production has been supplemented by imported timber for domestic timber needs for raw materials. Between 1990 to 2016 import volume of industrial roundwood and sawnwood grew by 130% and 705%, respectively. In fact, imports of wood-based panel products have increased tremendously between 1990 and 2016 as shown in Table 2.

Table 2: Production and trade of major forest products in Malaysia

Product	Unit	Production			Export			Import		
		2016	1990	% change	2016	1990	% change	2016	1990	% change
Industrial roundwood	thousand m³	13856	41260	-66%	2844	18084	-84%	23	10	130%
Sawnwood	thousand m³	3423	8849	-61%	1981	5332	-63%	228	28	705%
Wood-based panels	thousand m³	5411	1473	267%	4258	1058	303%	1279	56	2174%
Plywood and veneer	thousand m³	3656	1363	168%	2657	1017	161%	643	30	2043%
Particleboard, OSB and fibreboard	thousand m³	1755	110	1495%	1602	41	3808%	636	26	2323%

Source: FAOstats-Forestry database

International trade of forest products has undergone intense changes over the years as a result of various factors including globalization, population growth, economic growth, rising energy prices, environmental policies and regulations, and technology development that affect the production and consumption of wood-based products. Global consumption of wood products is expected to increase especially in Asia, mainly stemming from the rapid growth in demand from emerging economies such as China and India (FAO 2009). Although Malaysia has traditionally focused its production for the export market, local market consumption will undoubtedly increase in the future given the rapid development of the domestic economy coupled with the growing population.

▶ FOREST PLANTATION IN MALAYSIA AND ITS ROLE TOWARDS SUPPLEMENTING RAW MATERIALS FOR THE WOOD-BASED PROCESSING INDUSTRY

Based on the previous discussion, there is a need for concern on the dwindling supply of timber from natural forests in meeting the growing demand for wood-based products. In this regard, forest plantation has long been recognized to play an important role in reducing reliance on the natural forest as the main source for timber. In fact, forest plantation in Malaysia began way back in the early 1920s with trial plots establishment to rehabilitate and restore degraded forest areas caused by tin mining and farming in several locations in Selangor using native and exotic tree species (Hashim et al., 2015). The first large-scale commercial forest plantation, however, only started in 1967 with the establishment of softwood plantation using tropical pines and araucarias in a relation to a proposed pulp and paper mill in Peninsular Malaysia (Freezailah and Fielding, 1971). Nevertheless,

planting efforts ended due to the discontinued proposed pulp and paper mill project and lack of natural regeneration of the pine species under local climate conditions (Abd Latif et al., 2018). In 1985, the Compensatory Forest Plantation Programme (CFPP) was initiated with a total target reforestation area of 188,000 ha with fast-growing exotic species including *Acacia mangium, Eucalyptus spp., Gmelina arborea, Maesopsis eminii and Paraserianthes falcataria*. Of all of these species, *Acacia mangium* were planted in most of the reforestation project area due to better site adaptability and growth performance. The reforestation project, however, suffered from many problems including the incidence of heart rot disease.

Realizing the importance of forest plantation in supplying raw materials for the wood-based industries, government efforts to increase the sustainable supply of wood from plantation sources continue in 2003 with the introduction of forest plantation development program administered by the Ministry of Primary Industries. Unlike the previous reforestation program, the new forest plantation program involves full private sector participation to establish large-scale commercial forest plantations. A total of 375,000 ha of forest plantations were targeted to be established by 2020 which focused mainly on two species namely Rubberwood (*Hevea brasiliensis*) and *Acacia mangium*. Other additional species promoted under the program include Teak (*Tectona grandis*); Sentang (*Azadirachta excelsa); Khaya (Khaya ivorensis/ Khaya senegalensis); Kelempayan/Laran (Neolamarckia cadamba*); Batai (*Paraserianthes falcataria*) and Binuang (*Octomeles sumatrana*) (MTIB, n.d).

In Peninsular Malaysia, forest plantations must be developed on a state or alienated (privatized) land with prior approval from the state forestry departments. In Sabah, approved areas are in zones for Industrial Tree Plantation (ITP) under the Sustainable Forest Management License Agreement (SFMLA) while in Sarawak areas with a License for Planted Forest (LPF) can be developed (Abd Latif et al., 2018). As of 2016, a total of 114,355.43 ha have been developed in Peninsular Malaysia under the forest plantation development program involving about 50 companies with an expected yield of 700,000 m^3 of timber to be harvested in the beginning 2021 (Bowden, 2018). In Sabah, a total of 238,000 ha out of a targeted area of 400,000 ha had been planted in 2012 largely with *Acacia mangium, Paraserianthes falcataria, Eucalyptus grandis, Eucalyptus deglupta, Eucalyptus pellita, Neolamarckia cadamba, and Dipterocarp* spp. (Anon, 2012). Meanwhile in Sarawak, by 2009, a total of 238, 641 ha out of 2.8 million ha approved areas have been planted with different species mainly *Acacia Mangium, Neolamarckia cadamba, Paraserianthes falcataria, and Eucalyptus* spp. (Forest Department of Sarawak, n.d.).

The surge in total plantation areas over the years in Malaysia indicates the important role of forest plantation in supplementing timber from the natural forest for the wood-based industry. Indeed, forest plantation has received great attention and support from the government. Nevertheless, several issues and challenges faced by the forest plantation industry need to be addressed carefully since Malaysia's experience in forest plantation can be considered at an early stage, although forest plantations have started over a century ago (Hashim et al., 2015). Among of the issues include extensive use of exotic species which has several drawbacks in terms of pest and disease incidence, invasiveness and other environment, ecological and biodiversity effect, lack of silvicultural knowledge and growth and yield data especially for native timber species, access to forest lands especially in Sabah and Sarawak which may potentially have an impact to the local people livelihood, and other technical and economic issues such as economic feasibility.

▶ CONCLUSION

Based on the previous discussions, forest plantation is playing an increasingly important role in reducing the gap between natural forest timber supplies and demand from the wood processing industry for raw materials. Efforts from both government and private sectors are needed to determine how plantation can be environmentally, technically, economically, and socially feasible to ensure a sustainable forest plantation in Malaysia that benefits not only the wood-based industry but also to the national economy and the whole society.

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INTROPica
HIGHLIGHTS

CONTROL BEFORE IT GROWS: MICROCLIMATE AND FOREST PLANTATION FIRE

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INTRODUCTION

Forest plantation is an area with planted trees that will be harvested and aimed for the direct or indirect use for human needs (Borges et al., 2016). Due to an increase in the demand for timber, many forest plantations are established and, in many cases, fast growing species such as pines and eucalypts are used and even being planted besides their native setting (Rivera, 2017). According to Payn et al. (2015), planted forest areas throughout the world has increased from 167.5 million ha in 1995 to 277.9 million ha in 2015 with the increase varies according to the region and climate condition.

Alteration of the natural landscape to these forest plantations leads to the changes in vegetation structure, thus affecting its microclimate conditions. Changes in microclimate conditions added with climate change effect, influence the rainfall patterns that consequently may influenced fire occurrence (Mann et al., 2016). Significantly, beyond the wood production from forest plantations, it is highly expected that the plantations are managed in a way that they will enhance ecosystem services such as microclimate mitigation (Pawson et al., 2013; Paquette and Messier, 2010) thus reduces fire occurrence.

MICROCLIMATE AND FOREST PLANTATION SUSCEPTIBILITY TO FIRE

The risk of the planted forest will increase mainly from direct climate events such as the occurrence of storm, but the risk will also increase in case of fire (IPCC, 2014). PAR is the best predictor of fire spread and its influence on flammability is directly and indirectly linkable to other microclimate parameters such as solar radiation, relative humidity and rainfall (Just et al., 2016). In addition, the interception of PAR or solar radiation is greatly dependent on the tree canopy cover and tree height as these are the factors that influence the understory light (Martens et al., 2000). The canopy cover and tree characteristics determine the solar radiation penetration below the canopy thus can influence the microclimate of the area as well as the vegetation on the ground. Moreover, this will consequently be affecting the soil moisture conditions of the area. The combination of the alteration of the surrounding areas extreme weather events such as heat waves and drought will eventually expose these planted forest areas to the risk and disturbances from fire events.

In significance, the forest plantation susceptibility to fire is due to the plantation is habitually characterized by areas covered with grass, weeds or bushes that are highly flammable especially in dry conditions and more vulnerable for plants in the age of less than five years (FAO, 1993). Moreover, dense forest plantations occupied with fast growing, highly flammable species such as pines and eucalypt that are mainly planted for commercial purposes, prone to develop high intensity and severe large fires (Fernandes et al., 2016). Consequently, this may be a threat to economic, biodiversity (van der Werf et al., 2010), society and the timber industry, especially if it is exacerbated with frequent and severe drought events (Gómez-González et al., 2018). For instance, fire events such as the Black Saturday fires that had happened in Australia in 2009, where approximately 30 kha of a rugged landscape extensively afforested with eucalypt and pine plantations were burned that consequently affected many lives (Gómez-González et al., 2018).

Worryingly, there is an increasing trend in the conversion of many areas in tropical countries to Eucalyptus plantations for pulp production (Vasconcelos et al., 2019). The establishment of this fast growing species in many tropical regions may be an indication that more suitable, specific and intensive strategies should be planned for forest plantations as the preparation in reducing the risk of fire occurrence and disturbance.

MICROCLIMATE AND FIRE MITIGATION STRATEGIES FOR FOREST PLANTATION

Fire events can disturb the dynamic equilibrium of an area and consequently will not only be a liability to human lives but also can damage the surrounding infrastructures and increase air pollution (White et al., 2015). The microclimate mitigation strategies are especially important for forest plantations that are located close to highly urbanized areas. The urbanized areas are regularly characterized with hotter and drier conditions as well as an increase in wind speed. This will be an influential factor in the increase of fire risk not

only to the urban areas but also to the forest plantation as well. This risk can be mitigated through the increase in tree canopy covers throughout the urbanized areas that can strategically improve the microclimate conditions (Li & Song, 2019; Sanusi et al., 2016).

On the other hand, for the management of forest plantation, the silvicultural activities applied to the planted forest can determine the influence of fire disturbance. For instance, according to a study by Cruz et al. (2017), pruning and thinning activities had significantly changed the plantation fuel complex and affected the fireline intensity where it was recorded that the thinning reduced signified fire intensity during Very High Fire Danger days.

Several other strategies for microclimate and fire mitigation are designing road and firebreaks in for the forest plantation, removing the weed and grass as well as establishing intercropping of plants in between the main tree crops (FAO, 1993). Litter on the Eucalyptus plantation floors may act as a protective barrier against erosion, but the removal is important to reduce fire hazard (Bayle, 2019). In addition, the surrounding communities and other stakeholders should also be encouraged to participate in the microclimate and fire mitigation strategies. The land managers, if possible, extinguishing the fires as soon as it started (Rivera, 2017) and increase in awareness among local people surrounding the forest plantation area are usually preferable and can reduce the impact of fire events (FAO, 1993).

Moreover, fire alert is one of the beneficial strategies for early warning of the potential occurrence of fire events. This fire alert will be a powerful tool for fire prevention strategy as it evaluates and predicts the fire susceptibility possibility daily through the consideration of the weather conditions of an area (White et al., 2015). By determining the fire alert, it serves as an important warning for the communities that surround the affected areas and better management and planning can be made for forest plantation and human protection.

In addition, diversity and discontinuity of landscapes and infrastructures surrounding the areas to hinder fire progression that consequently will decrease the spread of fire to other areas (Ferreira et al., 2015). In significance, before the establishment of forest plantation, the fire ecology context should be put into consideration to ensure the success of fire management planning and improvement in regulation and science-based management policies are strongly needed so that the effectiveness of the planned strategies can be optimized (Gómez-González et al., 2018).

The forest plantations are particularly vulnerable to fire events as well as the growing importance for the forest plantations to be capable in providing various ecosystem services. Therefore, in ensuring the continuation forest plantation contribution to the ecosystem services primarily for the mitigation of microclimate and consequently reducing fire occurrences, climate adaptation strategies should be developed, and forest health must be the main focus for the plantation as well as more research in these areas should be established (Payn et al., 2015).

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INTROPica
HIGHLIGHTS

THE REVIEW OF SOCIO-ECONOMIC IMPACT STUDIES IN FOREST PLANTATION

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Industrial forest managers and conservation scientists agreed that forest plantations play a role in conserving biodiversity and will occupy an increasing proportion of future landscapes. For example, in year 2002, 3% of the world's forests are planted which covered by 60 million hectares in the developed nations and 55 million hectares in developing nations (WRI,1998; FAO, 1999, Hartley, 2002). Forest plantations cover a major proportion of forest area, including 44% in Japan, 20% in New Zealand, and over 90% in Britain (Donald et al., 1997; FAO, 1999). Though tropical forest cover is deteriorating, tropical forest plantation area has increased dramatically, ''from about 10 million hectares in 1980 to about 44million hectare in 1990'' (Lugo, 1997). Demand for wood products is increasing followed as the population, and will continue to increase into the 21st century (Nambiar,1984; FAO, 1999).

As the land cover for forest plantation is increasing, the socio-economic impact of the plantation is becoming a central issue. This article is to review various methodologies to assess socio-economic impact specifically in forest plantation or agroforestry plantation. Among the socio-economic impact variables include population, non-permanent population, wage economy, employment by industry, labour force, educational attainment, and income. There are methods to assess the impacts and benefits, namely cost-benefit approaches, livelihood analysis, and others.

Table 1 shows the socio-economic impact variables related to Eucalyptus forest plantations. There 5 main variables mostly studied by the researchers. It becomes the main source of wood and energy, provides employment, generates income, develops infrastructure, and offers natural resources availability.

Table 1.0 Socio-economic impact variables

Socioeconomic Impact	References	Explanation
1. Source of Wood and Energy	Zaizhi, 2002; Mekonnen et al., 2007; Alemu, 2016	• Meets household subsistence need • Household energy source - Fuelwood • Construction materials, building materials, furniture
2.Employment	Zaizhi, 2002; FAO, 2011; Hamid and Abdalla, 2015; Alemu, 2016	• Job creation by the plantation company - • especially for an unskilled worker. It helps poor households who are jobless.
3. Income	Zaizhi, 2002; Mekonnen et al., 2007; Bekele, 2015; Alemu, 2016; Daba, 2016; Zerga & Woldetsadik, 2016;	• Eucalyptus increases economic income - increase in wood demand and prices make this species profitable. • Income generation through employment • Income generation through cash crop - produce timber and non-timber products not only for the household consumption but also for sale at the market.
4. Infrastructure	Zaizhi, 2002; Degnet et al., 2017; Landry & Chirwa, 2011; Pirard et al., 2017; D'Amato et al., 2017	• Eucalyptus plantation company provide the financial support for local infrastructure - school construction, electricity, tap water, roads, bridges and irrigation system
5. Natural Resources Availability	Tadesse & Tafere, 2017; Chanie et al., 2013; FAO, 2011; Zegeye, 2010; Chanie et al., 2013; Daba, 2016; Yitaferu et al., 2011;	• In terms of water availability. • Lessening in groundwater availability. • The rapid growth of the Eucalyptus with deep & solid rooted would lead to decrease and drying out of formerly functional water stores nearby in the watershed.

Table 2 provides the information on the uses of Eucalyptus plant. There are five main uses of the Eucalyptus plant; to produce wood, possess therapeutic values (medicinal and aromatherapy), provide household necessities and ecosystem services. Wide range of applications drives the socio-economic impact values, as it shows the community could further develop the value chains into small and medium enterprises.

Table 2: The uses of Eucalyptus plant

Uses of Eucalyptus	Description
Wood Production	• Timber, wood for all type of construction (heavy, utilitarian, light construction) and also as floorings, building and furniture.
Medical Use	• The Eucalyptus oil is good to restore human health such as healing fever, cough, diabetes, respiratory system, insect bites and remedy for muscle and joint pain.
Household Consumption/ Production	• An important source of fuelwood in most of the rural area. This is due to its usage as household energy and cooking purpose. • Can be utilised as a household product such as soap and cleansers (antibacterial properties and refreshing properties).
Aromatic Properties	• The pleasant smell of Eucalyptus is useful for the aromatherapy purposes • The leaves can be used as herbal teas to comfort, make calm and even act as a cold reliever.
Ecosystem Services	• Lower down global warming and at the same time helps animals find natural shelter. • Good for the purpose of the windbreak, aesthetic value and landscaping.

Source: FAO, 1993, FAO, 2011; David, Gabriel and Luther, 2017; Treecoin, 2019; Dessie et al., 2019.

Forest plantations have a significant impact on the community. The method in evaluating the impacts are important, as it determines the policies link to industry development. The purpose of assessing the socio-economic impact is to inform policies. Various policies are in favour to upgrade socioeconomic status, however, the limitations in the information regarding the variables of socio-economic impacts made it difficult to assess.

We presented in Table 3.0 the studies which employed the socio-economic impact method in their studies. Cost-benefit analysis is an established method in studying the socio-economic impact and field visits and interviews are the most common method to obtain the information for the studies.

Table 3.0 Socio-economic research methodology and its scope

Author/Year	Method/Data	Study scope
Gessesse Dessie and Teklu Erkossa/ 2011	Desktop study based on reports, journal articles, and field visits to Rwanda and Ethiopia.	To provide a balanced perspective of socio-economic and environmental impacts of Eucalyptus forest plantation in East Africa.
Jennifer Landrya, Paxie W. Chirwa/ 2010	Livelihood analysis. Data collected using interviews and secondary data.	Assessment of livelihoods of rural households in greenfield forestry of Niassa province, Mozambique.
Janske van Eijck, Henny Romijn, Annelies Balkema, André Faaij / 2014	Cost-benefit analysis, processing cost, yield revenue, the value of by-products, interviews and observations based on issues (i.e, food security, local prosperity, labour working conditions, land rights).	Assessment of key economic, environmental and social issues in jatropha biofuels. To provides an overview and identify knowledge gaps.
Bill Slee/2005	Cost-benefit approaches, regional economic analysis, sustainable livelihoods, community benefits, economic welfare, landscape identity, environment and natural quality.	Highlighting methods devised to evaluate the contribution of forestry to rural development at regional or sub-regional level in the UK.
Maria Rosaria Di Nucci, Christina Spitzbart/2010	An integrated methodological framework, a set of criteria and tailored tools.	To share the results of the CONCERTO initiative. The different publications will provide information to relevant actors aiming to implement sustainability projects in cities across Europe.

A holistic and rigorous framework is needed to study the socio-economic impact of forest plantations. Reviewing the methods and the variables in the socio-economic impact of forest plantations studies is important in developing a comprehensive framework.

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INTERNET OF THINGS (IOT) INITIATIVE IN MALAYSIA FOR FOREST FIRE MONITORING

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In the support of:

INTRODUCTION

IoT has a great potential to be implemented in Malaysia as many researchers apply this technology in their research. One of the biggest potentials of IoT implementation is in the peat fire management in Southeast Asia countries such as Malaysia, Indonesia and Brunei. INTROP, Faculty of Engineering and MIMOS Berhad research team has proposed an IoT system to be implemented in Raja Musa Forest Reserve (RMFR), Bestari Jaya, Selangor. The proposal entitled "NAPC: Networked ASEAN Peat Swamp Forest Communities" was proposed to National Institute of Information and Communication Technology (NICT) Japan. In 2018, approval letter was received by ASEAN IVO Steering Committee and this project was listed under ASEAN IVO 2018 program. The fund was granted in January 2018 and initiated on 1st July in the same year. The duration given to the project is 24 months. The first face-to-face (F2F) meeting was successfully conducted on 13 to 14 Aug 2018 at La Apparenti, UPM followed by 2 days of pre-visit to RMFR (Figure 1).

Figure 1.0 A field visits to Raja Musa Forest Reserve (Education Centre) was conducted in August 2018 with NICT research team.

NATIONAL INSTITUTE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY (NICT)

NICT or National Institute of Information and Communications Technology (NICT) is one of Japan's sole National Research and Development Agency specializing in the field of information and communications technology. The institute is charged with promoting ICT sector as well as research and development in ICT, which drives economic growth and creates an affluent, safe and secure society. Further details of the project can be found in NICT website.

STUDY SITE

The project is a jointly conducted with other ASEAN countries as described in the table below. Each of the countries chosen suitable area to test this system within their forest fire issue. Overview of Raja Musa Forest Reserve, Selangor located in Peninsular Malaysia was chosen as a tested site for Malaysia team (Figure 2.0).

Table 1.0 ASEAN Countries involve in this project and location of the research areas.

Country	Study Site	Location/District
Malaysia	Raja Musa Forest Reserve	Selangor
Brunei	Badas Peat Dome	Brunei
Vietnam	Ca Mau Peat Swamp	U Minh Ha
Indonesia	Sebagau Park	Central Kalimantan



IOT SYSTEMS

The study employed climatological sensors for acquiring climatic condition of the peat lands for forest fire monitoring activity. The tower mounted with several sensors namely, relative humidity, air temperature, light intensity, and camera. At the same time water level, soil moisture, temperature and other related to peat swamp environmental characteristics sensors were also included and installed at the peat land. As we know, during January to April every year ASEAN countries were triggered by forest fire event. This type of data is very important for this area particularly during drying period.

Data is collected by the sensors, stored and transfers to server to be utilized by users which will be identified later. For this study the user can be Forestry Department, BOMBA and villagers. Based on identified cloud server data will be received and stored by the manager, which then waiting for downloading for analytical usage. The proposed systems is showed in Figure 3.0.

EXPECTED OUT

The project enables connectivity for IoT-based monitoring system in peat swamp forest areas in all the ASEAN countries involved. The benefits are namely:

1) To enable the forest management community and researchers to understand more about the peat management issues and ecosystem;
2) To serve as pilot projects for IoT-based monitoring systems for Malaysia and other ASEAN countries participated.

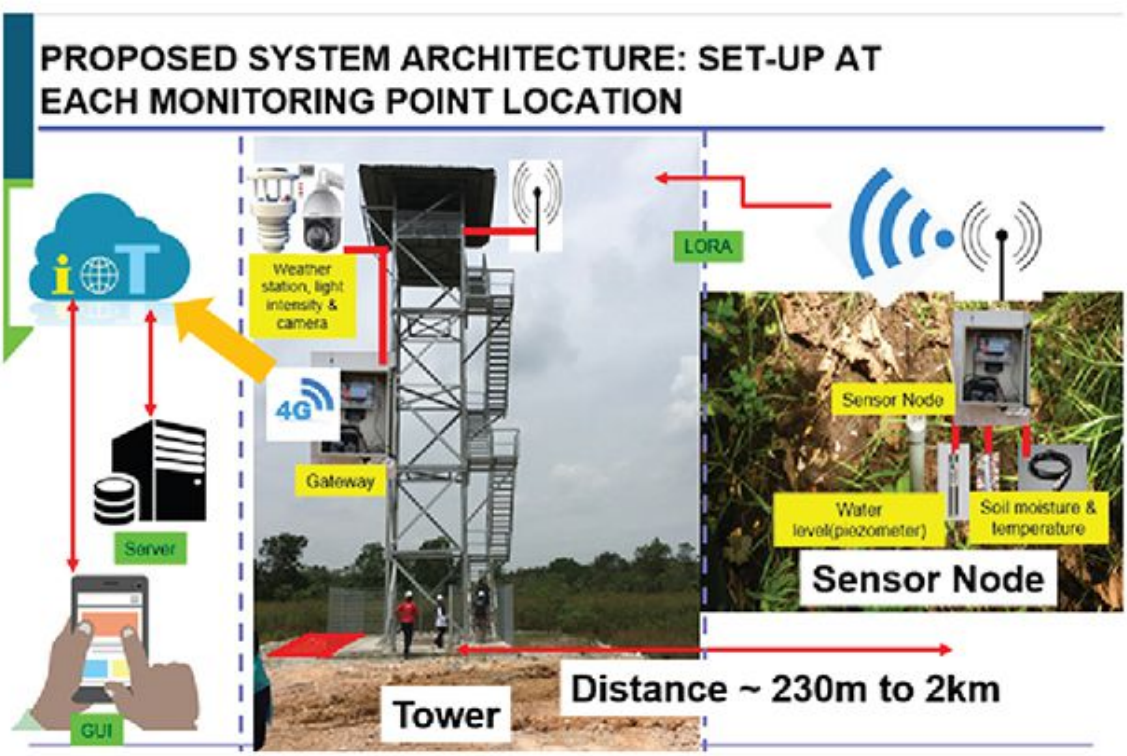

Figure 3.0 Proposed systems at the peat land

ACTIVITIES

SUSTAINABLE DEVELOPMENT IN AGRICULTURE AND FORESTRY SEMINAR

Venue: Mini Auditorium, Deputy Vice Chancellor Research and Innovation Office UPM
Date: 14 February 2019

The Office of Deputy Vice-Chancellor (Industry & Community Relations), Institute of Tropical Forestry and Forest Products (INTROP), Institute of Agricultural and Food Policy Studies, and Institute of Tropical Agriculture and Food Security (ITAFoS) have co-organized a Seminar on "Sustainable Development in Agriculture and Forestry" to 42 delegates from The Institute of Higher Studies for Science and Technology (IHEST), France. The seminar was in conjunction to the one week case study visit to Singapore and Malaysia as part of their National Training Course. The visit to these countries was aimed to make them discover environments that are unfamiliar to them. It is believed to help them as the senior executives, scientists, industrial entrepreneurs, elected officials and opinion leaders to understand the myriad ways in which the scientific, educational, cultural, social, economic, and political spheres interact. UPM was selected as one of their focal point in Malaysia to discuss issues regarding sustainable agriculture and forestry. The seminar focused on the development journey of the oil palm industry in Malaysia and its achievements and challenges. Prof. Dr Zulkifli Idrus, the Deputy Vice-Chancellor (Research and Innovations) presented UPM's journey and achievements in research and development activities. Dr. Jean Marc Roda, presented on a topic of Geopolitics on Forestry, Agribusiness and Food security. Dr Marcel Djama, presented on a topic of Palm oil Achievements and Challenges: Perspectives from Malaysia. Both Dr Roda and Djama are scientists from CIRAD, France, who are the research fellow at UPM. The delegates were actively participating in debating the issues, as currently there is a tension between European countries towards oil palm development. The delegates were divided into three groups to visit the respective institutes. They had the opportunity to meet and interact with the students and researchers who are involved in various research on the oil Achievements and Challenges: Perspectives from Malaysia. Both Dr Roda and Djama are scientists from CIRAD, France, who are the research fellow at UPM. The delegates were actively participating in debating the issues, as currently there is a tension between European countries towards oil palm development. The delegates were divided into three groups to visit the respective institutes. They had the opportunity to meet and interact with the students and researchers who are involved in various research on the oil palm.



INTROP INNOVATION OPEN DAY 2019

Venue: OSH Hall & INTROP, UPM
Date: 13 March 2019

INTROP Innovation Open Day (IO Day 2019) 2019 was successfully organized by the Institute of Tropical Forestry and Forest Products (INTROP) on 13 March 2019 with the presence of a total of 70 people comprising government agencies, industries and communities. The ceremony was officiated by En. Shahril Nizam Idris, Principal Assistant Director of Center for Excellence (CoE), IPT Excellence Planning Division, Ministry of Education Malaysia. Also present at the ceremony were Prof. Dr Zulkifli Idrus, UPM's Deputy Vice-Chancellor of Research and Innovation and YBhg. Brig. Gen Dato 'Hj. M. Nazri Bin Dashah RMAF, President of Malaysia UAV Drones Activist Society (MUDAS) to sign a Memorandum of Understanding between UPM and MUDAS. In the officiation speech, Prof. Dr Zulkifli Idrus, Deputy Vice-Chancellor (Research and Innovation) UPM emphasizes the effort to intensify collaboration between academia at universities and industry to achieve innovation goals in research. The main objective of this program is to foster collaboration with external agencies and industries and sharing experience in the research niche area of tropical

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wood and fibre and to provide a platform to disseminate the latest updates on research activities on fibre and wood-based innovations in INTROP. It is hoped that such efforts will continue in the future to further enhance the collaboration networks with industries and communities in upholding research and innovation in Universiti Putra Malaysia.

NATIONAL SEMINAR OF ENAU 2019

Venue: Bahau, Negeri Sembilan
Date: 1 April 2019

The Enau Malaysia Development and Industry Association (PPIEM) with the Institute of Tropical Forestry and Forest Products (INTROP), with the support of the Advanced Engineering Materials and Composites Research Centre (AEMC), Universiti Putra Malaysia and Hafiz Adha Enterprise has organized the Seminar Enau National 2019 which took place in Bahau, Negeri Sembilan. The Enau National Seminar 2019 provides an excellent platform for industry, academics, researchers, policy makers, students, administrators and financiers to share ideas and research findings and discuss issues related to the extraction, use and production of biofiber from various sources, especially fibre bio of enau tree and its potential application. PPIEM and INTROP have made strategic decisions to expand the scope of the seminar to include all relevant topics, covering all biofiber, and ensuring the development and importance of the wood and bio-fuel sector to global bioeconomics. In addition, the Enau Open Day program with locals and Enau operators throughout Malaysia is also being implemented to expand the potential for oak trees to be exported abroad and thus generate continuous income to Enau entrepreneurs. The Enau National Seminar 2019 also aims to unify the industry (enau entrepreneurs), and academics to discuss the latest developments in the industry, from agriculture-related topics to downstream fibre production processes and product development.

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KUALA LANGAT PINEAPPLE HUB DEVELOPMENT PROGRAM

Venue: Teluk Panglima Garang, Selangor
Date: 20 April 2019

The Kuala Langat Pineapple Hub Development Program was successfully launched on 20 April 2019 at the MPKK Hall, Kampung Batu 10 Kebun Baharu, Telok Panglima Garang. The ceremony was launched by YB Dr. Xavier Jayakumar A/L Arulanandram, Minister of Water, Land and Natural Resources. The event was also attended by Vice-Chancellor of Universiti Putra Malaysia, Prof. Datin Paduka Dato' Dr. Aini Ideris, Vice-Chancellor of Universiti Tun Hussein Onn Malaysia (UTHM), Prof. Ts. Dr. Wahid Bin Razzaly, Director of Institute of Tropical Forestry and Forest Products (INTROP), Prof. Dr. Ahmad Ainuddin Nuruddin, Dean of the Faculty of Engineering UPM, Professor Dr. Nor Kamariah Noordin, and Director of the University Community Transformation Center (UCTC), Prof. Dr. Mansor Abu Talib. A group of experts led by Prof. Madya. Ir. Ts. Dr. Mohamed Thariq Bin Hameed Sultan in collaboration with Universiti Putra Malaysia (UPM) University Community Transformation Center (UCTC) has conducted a "Development of Novel pineapple leaf fiber fiber extraction machine for villagers from waste to wealth" programme involving villagers from Kampung Batu 10, Telok Panglima Garang. This programme had been started from March 2018 until March 2019 through a grant of UPM Science Scheme (KTGS) grant worth RM25,000. Kampung Batu 10 community is famous for the cultivation of oil palm and pineapple. In this area, there are more than 20 acres of land planted with pineapple trees. Typically, the remains of pineapple trees are often wiped out by burning or being left to rotten and this will cause problems to the environment. Normally, pineapple leaves are processed manually, however, more time are required for this process. Therefore, this project is being carried out by building a pineapple leaf extraction machine and a pineapple leaf community centre for farmers and villagers. This program is expected to assist the villagers in the extraction of pineapple leaf fiber by making it more efficiently, thus help to reduce the pineapple waste and change it from waste to the source of income. The pineapple leaf extraction machines are the outcome from the collaboration between UPM researchers lead by Assoc. Prof. Ir. Ts. Dr. Mohamed Thariq Bin Hameed Sultan and UTHM researchers lead by Prof. Dr. Yusri Yusuf. Pineapple leaves extracted into fibers can be used to produce other products. According to Head of Research from UPM, Prof. Madya. Ir. Ts. Dr. Mohamed Thariq Bin Hameed Sultan, this program is a knowledge transfer program to be delivered to target groups and can be used continuously. This program gives villagers the chance to build a mini pineapple leaf extracting machine and to help in generating income to the community. The program is also expected to create awareness on the environmental sustainability by recycling pineapple leaves. In addition, villagers were also been taught on the technology of developing machines. These skills will also help them to repair and maintain the machine by themselves.

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COLLABORATIVE MEETING WITH KKIP SDN. BHD.

Venue: Kota Kinabalu Industrial Park (KKIP) Sdn. Bhd., Sabah
Date: 21 May 2019

Six INTROP Researchers visited Kota Kinabalu Industrial Park (KKIP) Sdn Bhd in Sabah on 21st May 2019. The visit was attended by KKIP Sdn Bhd's Chief Executive Officer, Melvin G. Disimond, General Manager (Business Development), Lawrence G Kimkuan (Senior Manager, Business Development). KKIP Sdn Bhd is a wholly-owned subsidiary of Sabah State Government under the Ministry of Commerce and Industry, Sabah which focuses on developing sustainable socio-economic status in Sabah. In addition, the company has the potential to contribute to the transformation of Sabah to become an industrial based economy. Both sides exchanged views on various issues related to the development of wood-based industries in Sabah in particular. The visit aims to explore collaborative opportunities in the research and development of timber industry with agencies in Sabah.




VISIT TO WOOD INDUSTRY SKILLS DEVELOPMENT CENTRE (WISDEC)

Venue: WISDEC, Kota Kinabalu, Sabah
Date: 21 May 2019

Seven INTROP researchers went to visit Wood Industry Skills Development Centre (WISDEC) on 21st May 2019 in Kota Kinabalu. INTROP delegates were briefed by WISDEC's officers on the training they offered specifically on wood-based product development. The visit includes a tour at their laboratory and workshop area, to see their facilities and products that the trainees are working on. WISDEC as a training agency under Malaysian Timber Industry Board (MTIB) was established during Sixth Malaysian Plan (1991-1995) to carry out technical training, assist in product development, organizing furniture designs, and coordinating Malaysian Skills Competition. During the visit, both parties were discussing and exchanging views and experience on how to strengthen the trainees' and workers' skills in the wood-based industry.


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VISIT AND MEETING WITH SABAH TIMBER INDUSTRIES ASSOCIATION (STIA)

Venue: STIA, Kota Kinabalu, Sabah
Date: 22 May 2019

Seven researchers from INTROP visited Sabah Timber Industries Association (STIA) on 22nd May 2019. The meeting was attended by STIA's committee members, Joseph Fong Hen Vun (Vice President), Alfred Yong Chin Keong (Secretary-General), Sia Mee Kuong (Treasurer-General), Linda Loh Siew Lian, and Quek Siew Wah. The association is mainly to support, protect and promote the interest of the downstream wood processing industries in Sabah. The meeting is to discuss and understand the current issues and challenges faced by the timber industry players in Sabah in specific, and to explore the future collaboration to work together in maintaining the growth of timber industry in Malaysia.



VISIT TO SABAH FORESTRY DEVELOPMENT AUTHORITY (SAFODA)

Venue: SAFODA, Kota Kinabalu, Sabah
Date: 22 May 2019

Five researchers from INTROP visited Sabah Forestry Development Authority (SAFODA) on 22nd May 2019. The meeting was attended by SAFODA's senior management team, including the Director. SAFODA is mainly to develop and manage forest plantation sustainably to produce high quality wood resources which contribute to the downstream industry and meeting stakeholders' expectation. The meeting is to discuss and understand the current issues and challenges faced by the forest plantation management authority in Sabah, and to explore the future collaboration to work together in maintaining the growth of forest plantation industry in Malaysia.

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COLLABORATIVE MEETING WITH UNIVERSITI MALAYSIA SABAH

Venue: UMS, Sabah
Date: 22 May 2019

Kota Kinabalu, Sabah – Seven researchers from INTROP visited Universiti Malaysia Sabah (UMS) on 22nd May 2019. The meeting was attended by UMS Deputy Vice Chancellor (Research & Innovation) Associate Professor Ts. Dr. Ramzah Dambul, Dean of Faculty Science and Natural Resources, Prof. Dr. Baba Musta, and other academic staffs from the faculty. The meeting is to discuss potential future collaboration on research and academic activities related to the natural resources field of study between the two universities.

VISIT TO SABAH ECONOMIC DEVELOPMENT AND INVESTMENT AUTHORITY (SEDIA)

Venue: Kota Kinabalu, Sabah
Date: 23 May 2019

Seven researchers from INTROP visited Sabah Economic Development and Investment Authority (SEDIA) on 23 May 2019. The meeting was attended by SEDIA Chief Executive Officer (CEO), Ybhg. Datuk Dr. Mohd Yaakub Hj. Johari, and Executives from various division. SEDIA is established to promote and accelerate the development of the Sabah Development Corridor (SDC) into a leading economic region and a choice investment destination for investment, work and living; and to ensure that social development and sustainable development are kept as priorities whilst driving economic growth in the SDC. The meeting is to discuss potential future collaboration on research and community program activities related to natural resources.

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JUNIOR GREEN SCIENTIST 2019

Venue: INTROP, UPM
Date: 29-30 May 2019

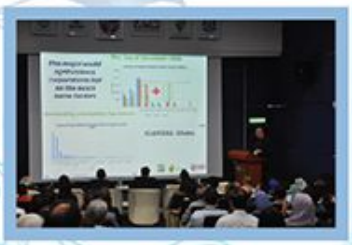
The Junior Green Scientist 2019 program is a community program for primary students that addresses the topic of green research in science and technology. It combines aspects of theory and skill to give participants a better understanding. The content covers preparation of raw materials, production and presentation of research results. The purpose of the program was to provide students with experience and knowledge in science and technology, promote the existence of the program to students in preparation for furthering university education and serving the community through programmatic channels. The program was attended by 10 students from Rafflesia International Schools and divided into 2 days. On the first day (29 May 2019), students were involved in Furniture Adventure project where they will be taught how to make furniture starting from plywood production and then they are being asked to produce their own furniture in groups. On 30 May 2019, they involved in Eco-Papermaking project. In the second project, they learned to produce their own paper from recycled paper and then studied the properties of the paper. At the end of the program, students were asked to present their findings during the 2-day program at INTROP.




'NUTELLA POLITICS' PUBLIC TALK AND MALAYSIAN PALM OIL AND GREEN GEOPOLITICS FORUM

Venue: Serdang Hall, Chancellery Building UPM
Date: 19 June 2019

141 people from various private companies, ministries, government agencies, public and private university students and UPM staffs attended the 'Nutella Politics' Public Talk and Malaysian Palm Oil and Green Geopolitics Forum held on June 19, 2019 at the Serdang Hall, Chancellery Building UPM. The program was officiated by Prof. Dr. Zulkifli Idrus, UPM Deputy Vice Chancellor for Research and Innovation whereas the talk was delivered by Dr. Jean-Marc Roda, a Research Fellow at Institute of Tropical Forestry and Forest Products (INTROP), UPM and a Scientist from CIRAD, France. The talk is expected to reinforce knowledge on current issues pertaining to the oil palm industry and the perception of the world community amongst students and researchers. After the Public Talk, there was a forum discussing on 'Malaysian Palm Oil and Green Geopolitics' and the invited panel speakers were M. R. Chandran, Advisor of RSPO; Dato' Dr. Kalyana Sundram, CEO of MPOC and Dr. Gary W. Theseira, Senior Officer from Ministry of Energy, Science, Technology, Environment and Climate Change (MESTECC).

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"CODE RED" COMMUNITY PROGRAM SEKOLAH KEBANGSAAN KAMPUNG TUNKU

Venue: SK Kampung Tunku, Petaling Jaya
Date: 22 & 29 June 2019

The Code Red Community Program was organized to assist weak students in Mathematics and English subjects for Years 5 and 6 at SK Kampung Tunku. A total of 45 students participated in the program in collaboration with PIBG and staff of BIOREM Laboratory, INTROP. The highlights of this program are the knowledge sharing sessions by Associate Professor Dr. Zaiton Samdin on environmental issues such as climate change and environmental pollution and measures to reduce the problem. Subsequently, students were divided into 11 groups and asked to create posters based on topics discussed on environmental issues with the assistance of facilitators and volunteers from UPM and PIBG school members. On June 29, 2019, each member of the group is required to present a poster created in the previous week in English to encourage students to communicate in English. Each group was judged based on creativity of the posters and the way they presented on the topic. The PIBG has provided positive feedback on the involvement of active and creative students in the preparation of posters and presentations on the topic and overall the program has achieved its objectives.

BRIS SOIL

BY: DALILA MURNI BINTI ALIAS
FACULTY OF SCIENCE AND MARINE ENVIRONMENT, UNIVERSITI MALAYSIA TERENGGANU

BRIS is an acronym for ***B**each Ridges Interspersed with Swales*

DID YOU

There are few series of BRIS soil such as Rudua, Baging, Jambu and Rhu Tapai.

BRIS soil has low plant diversity and mostly dominated by gelam trees.

BRIS soil are mostly found in coastal area of Peninsular Malaysia in Terengganu, Pahang and Kelantan.[1]

Fire prone area:
Inability to hold water[2]

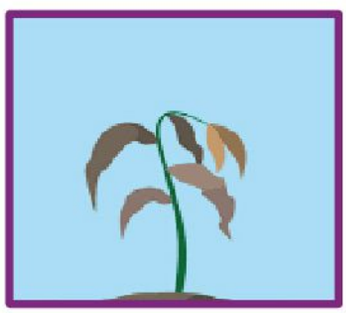
IS MADE UP OF
90%
OF SAND[2]

Unsuitable for agriculture since it is known as problematic soil.[2]

Drain well

Less fertile

Lack of nutrients



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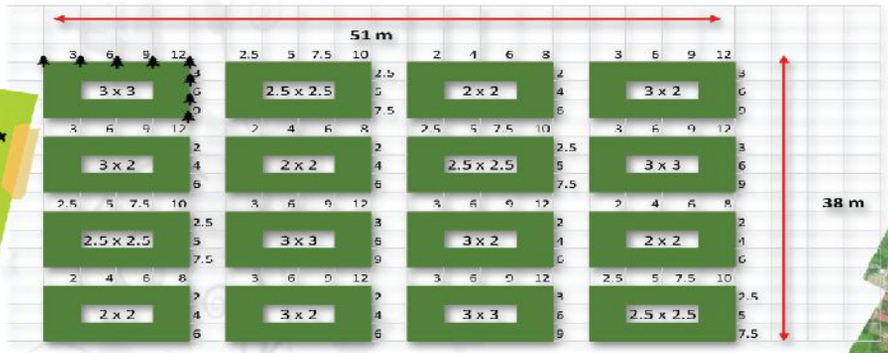
FOREST SPECIES TRIAL PLOTS

Planting Distance

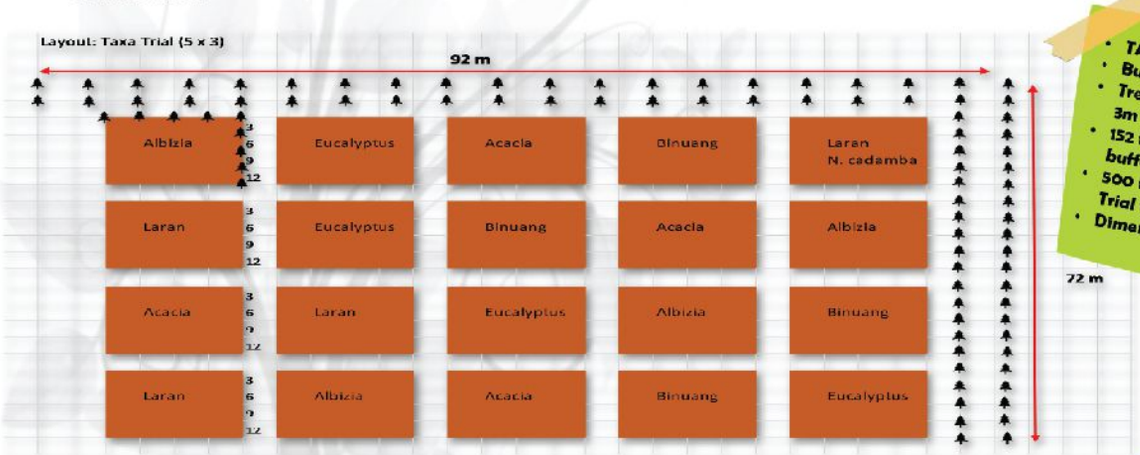
- 1 subplot, 5 trees x 4 trees = 20 trees/subplot
- Dimension = 51m x 38m



UAV
Unmanned Aerial Vehicle
(Drone)

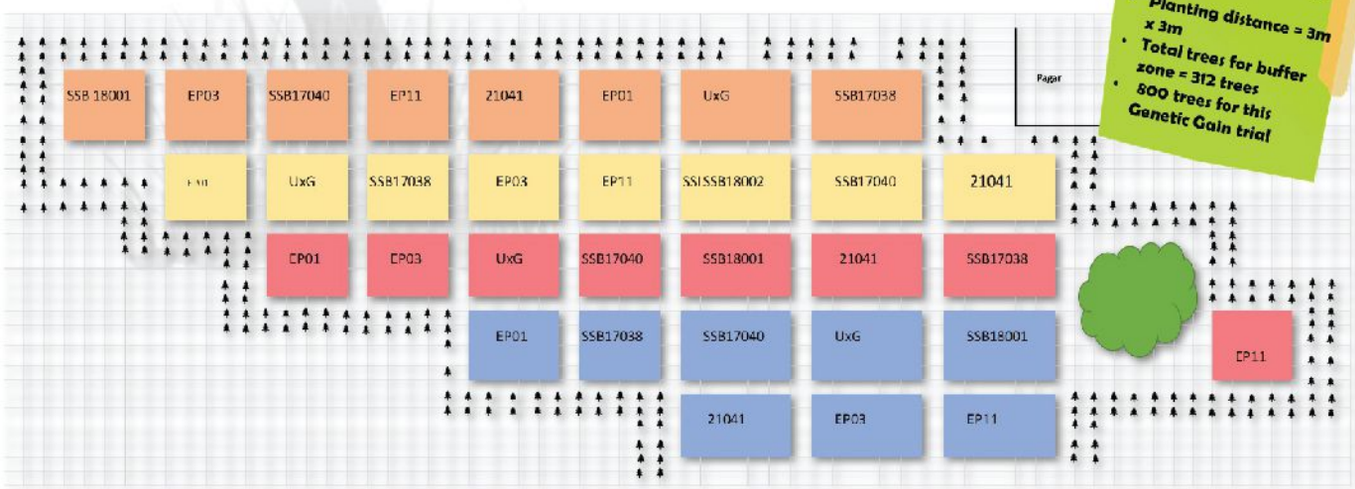
Camera Model	Resolution	Focal Length	Pixel Size	Pre-calibrated
FC6310 (8.8mm)	5472 x 3648	8.8 mm	2.41 x 2.41 μm	No

TAXA Trial



- TAXA Trial (5 X 3)
- Buffer zone = 5m x 3m
- Treatment plot = 3m x 3m
- 152 trees *Litsea* for buffer zone
- 500 trees for TAXA Trial treatment
- Dimension = 92m x 72m

Genetic Gain Trial



- Genetic Gain (3 x 3)
- 1 subplot = 5 trees x 5 trees
- Planting distance = 3m x 3m
- Total trees for buffer zone = 312 trees
- 800 trees for this Genetic Gain trial

PHYTOREMEDIATION

Siti Subaida Binti Subaidi
Faculty of Science and Marine Environment, Universiti Malaysia Terengganu

Mechanisms[1]

Phytofiltration
Remediate extracted groundwater, surface water and wastewater

Phytostabilization
Immobilization of heavy metals in soil

Phytodegradation
Extract, metabolize and degrade the organic contaminant

Phytoextraction
Extraction of heavy metals from roots into aboveground tissues of plant

Phytovolatilization
Extraction and transpiration of a contaminant by a plant

Aesthetically Pleasing

Help Maintain forest lanscape

plant-based advancement to degrade environmental contaminants and to metabolize diverse pollutants

Example of plant species used for phytoremediation[3]

- *Tectona grandis*
- *Scirpus grossus*
- *Orthosiphon stamineus*
- *Centella asiatica*
- *Melaleuca cajuputi*
- *Ludwigia octovalvis*
- *Acacia mangium*
- *Typha domingensis*
- *Eichhornia crassies*

Advantages[2]

Involve trees planting instead of using conventional method with advanced technology

No use of machinery and advanced technologies

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