UPM
UNIVERSITI PUTRA MALAYSIA
BERILMU BERBAKTI

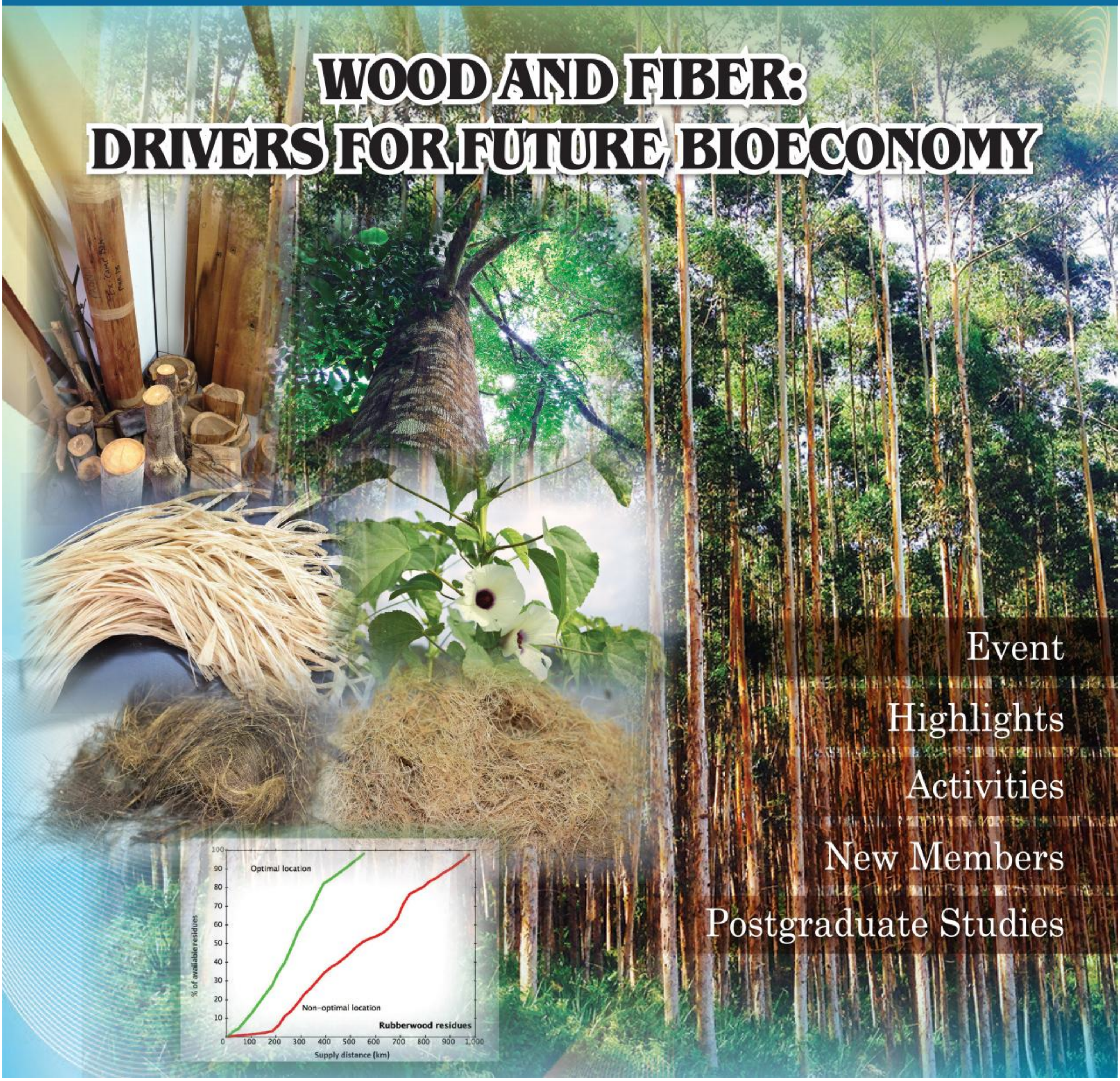
Issue 15·July-Dec 2017
ISSN No. 1985-4951

INTROPica

INSTITUTE OF TROPICAL FORESTRY AND FOREST PRODUCTS

Centre of R&D in Tropical Biocomposite and Bioresource Management

WOOD AND FIBER: DRIVERS FOR FUTURE BIOECONOMY



Event
Highlights
Activities
New Members
Postgraduate Studies

السلام عليكم ورحمة الله وبركاته

The 15th edition of INTROPica is published by the Institute of Tropical Forestry and Forest Products (INTROP), a Higher Institution Centre of Excellence for Research (HiCOE). INTROP is taking the lead in wood and fibre in biocomposite research while also growing its role in upstream research. Now in its 12th year, INTROPica is increasingly impactful through the publication of cutting-edge research.

Themed "Wood and Fibre: Drivers for Future Bio-Economy", this edition of INTROPica features eight high-impact research articles from UPM focusing on wood and fibre from palm, Eucalyptus, Agarwood and Kenaf.

In this issue, bio-economy strategies have been reviewed to provide comprehensive information on industry case studies in Malaysia. Technology and science are requisite in INTROPica, therefore, research on tree canopy technology mapping in upstream research is featured, illustrating its potential now and in the future.

Additionally, emphasis is given to the control of tree diseases which greatly influences tree mortality and can restrict wood and fibre growth. Also, an article on tree canopy provides tree health information especially for the maintenance of wood and fibre resources. Finally, a microclimate-related article in the urban forests area has also been presented in this magazine as it is a pathway to strategize bio-economy in Malaysia.

Researchers, especially those with keen interest in bio-economy will find this edition of the magazine both useful and engaging.

Your sincerely

The Editors

WOOD AND BIOFIBER INTERNATIONAL CONFERENCE 2017 (WOBIC2017)

Wood and Biofiber International Conference 2017 (WOBIC2017) was successfully held on 21st to 23rd November 2017 at Bangi-Putrajaya Hotel, Selangor. It was the first conference organized by Institute of Tropical Forestry and Forest Products (INTROP) which mainly focusing on wood and biofiber. The latter international conference organized by INTROP was known as International Conference on Kenaf and Allied Fibers (ICKAF) conducted in 2009 and 2013. WOBIC2017 was officiated by Malaysia Minister of Plantation Industry and Commodity, Datuk Seri Mah Siew Keong. The conference was co-organized with Malaysian Timber Industry Board (MTIB), Malaysian Palm Oil Board (MPOB), National Kenaf and Tobacco Board (NKTB), Forest Research Institute Malaysia (FRIM) and Fujian Agriculture and Forestry University (FAFU). Not to forget the collaborators: Asia Pacific Association of Forestry Research Institutions (APAFRI), Universiti Sains Malaysia (USM), Universiti Kebangsaan Malaysia (UKM), Universiti Tun Hussein Onn Malaysia (UTHM) and Politeknik Seberang Prai (PSP) who have given a full support to UPM in making this event a success.

The theme 'Lignocellulose for Future Bioeconomy' provided an excellent platform for industry, academia, researchers, policy makers, administrators, students and financiers to share ideas, findings and experiences on wood and biofiber parallel to the global bioeconomy initiatives. During the opening ceremony, there were MoU signings between UPM and two local industries which are MoU signing between UPM and MPMA (The Malaysia Panel-Products Manufacturers Association) which involves two projects: firstly on pre-commercialization of Marine-grade Equivalent (MGE) plywood from oil palm trunk, and secondly on the development of database for *Eucalyptus* plantation in Malaysia; and MoU and NDA signing between UPM and Nextgreen Pulp and Paper Sdn. Bhd. for a project on nanocellulose development from oil palm biomass.

The conference was joined by 188 participants comprises of 29 international and 159 local participants from 16 international and 15 local institutions respectively. The international participants came from 9 countries consisted of China, Japan, Thailand, Iran, India, Korea, Netherlands, Indonesia and Canada. The first two days of conference was filled with oral and poster presenters while technical and excursion took place on the third day. There were another two pre-conference workshop been conducted on the 15-16 November 2017 namely as Mechanical Characterizations of Biofiber and Biocomposite Materials, and Response Surface Methodology for Process Optimization. Based on survey evaluation analysis from the respondents, WOBIC2017 Organization Committee received excellent marks for all aspects listed as Conference Management & Coordination, Technical, Program and Miscellaneous. One of the exciting parts for all researchers is that an amount of 50 selected papers will be published in IOP Proceedings by early 2018. The next WOBIC is suggested to be organized in 2019 by one institution of WOBIC2017 Steering Committee members.

Speech quotes by *Datuk Seri Mah Siew Keong*

"The importance of fibres in our world today can be seen through its usage as a cash crop, especially in developing countries. The use of fibres does not only increase income levels for the rural community but is also important to some national economies. It cannot be denied that fibres are useful resource that is environmentally-friendly, and can be used in various industries, such as composites, pulp and paper, biopolymers, textiles, biofuels, biochemicals and other bioproducts industries. For instance, the need for renewable fibre reinforced composites (FRC) has never been as prevalent as it currently is. Natural fibres offer both cost-saving and reduced-density when compared to synthetic fibres. Although the strength of natural fibres is not as great as glass, aramid and carbon, the specific properties are comparable. The use of FRC has penetrated many new sectors such as automotive, buildings, sports and recreation, defence and to some extent; aerospace. To ensure the sustainability of these uses, a concerted effort must be gathered to strategize the right policies and its implementations right from the seeds source to planting and harvesting, processing, product manufacturing, marketing and quality assurance. This is where the researchers meet the entrepreneurs in a ***smart partnership."***

SUGAR PALM: FIBERS, BIOPOLYMERS AND BIOCOMPOSITES

S.M. Sapuan[1,2*] and R.A. Ilyas[1]
[1]*Laboratory of Biocomposite Technology, Institute of Tropical Forestry and Forest Products (INTROP), Universiti Putra Malaysia*
[2]*Department of Mechanical and Manufacturing Engineering, Universiti Putra Malaysia,*

Introduction

Synthetic fibers are dominantly used in the composites industry for the past several decades. However, the negative environmental and health effects associated with these fibers fueled the increasing usage of natural fibers as promising alternative. The escalating usage of natural fibers can be ascribed to their availability, affordability, processability, renewability, recyclability, biodegradability, specific tensile properties, less health hazards, acceptable insulating properties, low density and less energy consumption during processing over synthetic fibers (Sanyang et al., 2016). Natural fibers are classified depending on their origin either from plants, animals or minerals. However, natural fibers from plants are the most widely used reinforcement material in biocomposites. Plant fibers are subdivided based on the type of plants or parts of the plant the fibers were extracted included leaf, seed, stalk, fruit, grass fibers, and bast (Jawaid & Abdul Khalil, 2011). Malaysia has rich and vast untapped natural fiber resources available as potential alternative to synthetic fibers. These indigenous existing natural fibers range from kenaf, coconut trunk fibers, sugar palm fibers, sugarcane, sago, pineapple leaf, cocoa pod husk to oil palm fruit bunches oil palm fronds, oil palm trunks and many others. This article attempts to explore potential uses of one of the natural fibers namely sugar palm and its fiber composites to further develop sugar palm trees as a new crop in the near future.

Sugar Palm

Sugar palm (Figure 1.) belongs to the sub-family of Arecoideae and the tribe of Caryoteae (Dransfield & Uhl, 1986; Mogea et al., 1991). In 1917 during the International Congress of Botany in Vienna, it was officially named as Arenga pinnata. In Malaysia it is known as either enau or kabung. Sugar palm is a natural forest species that originates from the Palmae family. It is known as a fast growing palm that is able to reach maturity within 10 years (Mogea et al., 1991). It is a tall and large palm with a single unbranched stem which can grow up to 20 m high and 65 cm in diameter. Geographical distribution of sugar palm trees covers as wide as Asia to West Africa from Taiwan to the Philippines, Indonesia, Papua New Guinea, India, Thailand, Myanmar, Vietnam, North Australia, Malaysia, The Gambia, Senegal, Guinea Bissau and other West African countries (Ishak et al., 2013). Sugar palm is one of the most versatile palm species because almost all parts of the tree can be used, with at least 60 different products can be generated from a single sugar palm tree. This including palm neera, fresh juices, traditional sugar blocks, toddy, crystal and brown sugar, vinegar, bio-ethanol from sugar palm sap, edible hear from fruits, leaves for roofing, sea water resistant fiber, septic tank base filter, door mats, brooms, matting, baskets, cigarette papers, rope, chair/sofa cushion, cattle feeds from fiber and its starch inside the stem can be processed to make biopolymer (Ishak et al., 2013; Ilyas et al., 2016; Sanyang et al., 2016).

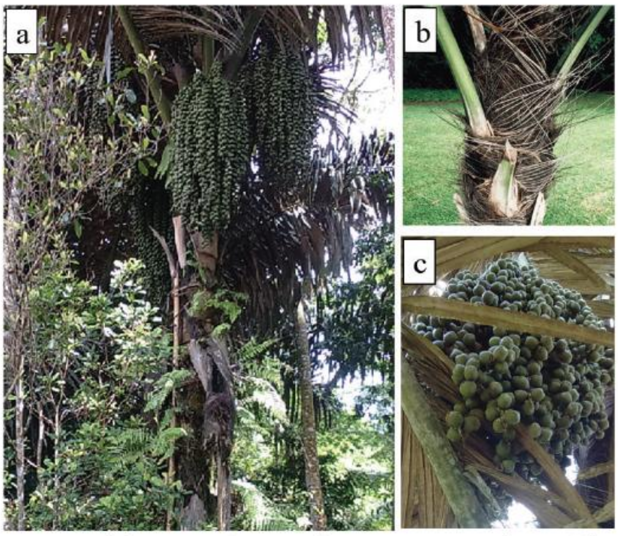


Figure 1. (a) Sugar palm tree (Arenga pinnata (Wurmb) Merr.), (b) sugar palm fiber, and (c) sugar palm fruit

Sugar Palm Fibers

Sugar palm starch (SPS) accumulates in the core of the stem of the sugar palm. Not all sugar palm trees yield sugar rich sap from the flower bunches. The non-productive palms can sometimes sum up to half the trees in a plantation. Starch is normally harvested from these unproductive trees following similar procedures as in the production of sago starch. The starch is extracted from the trunk of the sugar palm tree. It was reported that one sugar palm tree can yield 50–100 kg of starch. In the SPS extraction process, the sugar palm tree is brought down just before the first bloom and the trunk is split lengthwise to remove the woody fiber mixed with the starch powder from the inner soft core of the sugar palm trunk. This is followed by the washing process, where water was gradually introduced into the fiber and starch mixture and thoroughly kneaded by hand. The mixture is filtered to allow the water to flow through the sieve with starch granules in suspension. The starch is granted enough time to settle at the bottom of the container and the water is later decanted. Thereafter, the white powdered starch is kept in an open air for a moment and later dried in an air circulating oven at 120 °C for 24 h. Sahari et al. (2013) investigated the properties of SPS to explore their potential as a novel alternative polymer. SPS registered superior Amylose (37.60%) when compared to other starches such as tapioca (17%), sago (24–27%), potato (20–25%), wheat (26–27%) and maize (26–28%).

Sugar Palm Starch/Fibers as Reinforcement for Polymer Composites

Utilization of natural fibers with polymer matrices is essential for the mitigation of ecosystem devastation and provides low cost polymeric reinforced composites. The introduction of sugar palm fibers into polymer matrices further helps to address environmental problems associated with land filling of non-biodegradable conventional composites. In the past decade, a number of articles were published on sugar palm fiber reinforced polymers composites. Table 1 shows summary investigations on sugar palm fiber reinforced polymers composites.

Table 1: Summary of sugar palm fiber reinforced polymer composites research project at UPM

Researcher	Form of Fiber	Matrix	Process
Januar (2005)	Long Fiber	Epoxy	Hand lay-up
Suriani (2006)	Long Fiber	Epoxy	Hand lay-up
Bachtiar (2008)	Long Fiber	Epoxy	Hand lay-up
Zulkiflle (2009)	Long Fiber	Unsaturated polyester	Hand lay-up
Ridzwan (2009)	Long Fiber	Unsaturated polyester	Hand lay-up
Sahari (2011)	Frond, Bunch Fiber	Unsaturated polyester	Cold press
Sairizal (2011)	Long Fiber	Unsaturated polyester	Hand lay up
Ridzwan (2012)	Long Fiber	Unsaturated polyester	Cold press
Bachtiar (2012)	Short Fiber	Polystyrene	Compression molding
Hatim (2013)	Long Fiber	Thermoset	Cold press
Sahari (2013)	Ash	Sugar palm starch	Compression molding
Sanyang (2015)	Cellulose Fiber	Sugar palm starch	Solution casting
Ilyas (2017)	Nanocellulose Fiber	Sugar palm starch	Solution casting

Fiber Applications

Sugar palm fibers are extremely durable, even in contact with seawater. They possess good resistance to seawater and thus, use for making shipping ropes. A 12 ft (length) hybrid composite boat that was fabricated from the combination of sugar palm and glass fiber with unsaturated polyester as the matrix. In addition, a safety helmet was also developed from epoxy reinforced with sugar palm fiber. It is water resistant and could absorb and withstand high impact. The helmet was referred to as Helmet-Ijuk Reinforced Composite (HIReC). Besides, this strong fiber can be manufactured into broom, brush and portable composite table. The figures below show some of the fiber application such as broom (Figure 2), rope (Figure 3), boat (Figure 4), fibers used in automotive anti-roll bar (Figure 5), brushes (Figure 6a and b), portable composite table (Figure 7) and Helmet-Ijuk Reinforced Composite (HIReC) helmet (Figure 8).

Figure 2: Broom (NBOS project)

Figure 3: Rope from sugar palm fiber resistance to seawater

Figure 4: Hybrid composite boat combination of sugar palm and glass fiber with unsaturated polyester

Figure 5: Hybrid glass/sugar palm fiber reinforced polyurethane composite used in automotive anti-roll bar

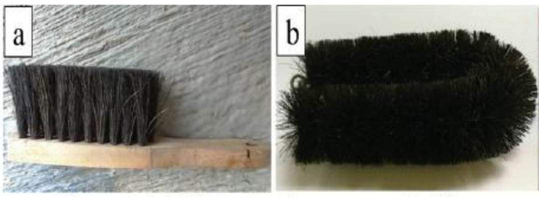


Figure 6: (a) (b) Brushes from sugar palm fibers

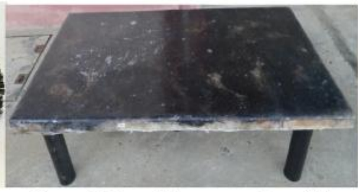


Figure 7: Portable composite table

Figure 8: Helmet-Ijuk Reinforced Composite (HIReC) (Credited to Dato' Ahmad Mujahid Mohd Zaidi, Universiti Pertahanan Nasional Malaysia)

Acknowledgements

The authors would like to thank the Management of Institute of Tropical Forestry and Forest Products and Universiti Putra Malaysia Grant scheme HICoE (vote number 6369107).

References

Abu Hatim, I. (2013), *Effects of Flame-Retardant Agents on Mechanical Properties and Flammability of Impregnated Sugar Palm Fibre-Reinforced Polymer Composites*, Master of Science Thesis, Universiti Putra Malaysia.

Bachtiar, D., Sapuan, S. M., Zainudin, E. S., Khalina, A., & Dahlan, K. Z. M. (2010). The tensile properties of single sugar palm (Arenga pinnata) fibre. IOP Conference Series: Materials Science and Engineering, 11(1), 012012.

Bachtiar, D. (2008), Mechanical Properties of Alkali-Treated Sugar Palm (Arenga Pinnata) *Fiber-Reinforced Epoxy Composites*, Master of Science Thesis, Universiti Putra Malaysia.

Bachtiar, D. (2012), Mechanical and Thermal Properties of Short Sugar Palm (Arenga Pinnata Merr.) Fibre-Reinforced High Impact Polystyrene Composites, PhD Thesis, Universiti Putra Malaysia.

Dransfield, J., & Uhl, N. W. (1986). An outline of a classification of palms. Principes, 30(1), 3–11.

Harpini, B. (1986). Quality improvement, product diversification and developing the potentials of sugar palm. Annual report for 1986/1987 of the Coconut Research Institute in Manado, Sulawesi, Indonesia. BALITKA: Manado. pp. 49–50

Ilyas, R. A., Sapuan, S. M., Sanyang, M. L., & Ishak, M. R. (2016). Nanocrystalline cellulose reinforced starch-based nanocomposite: A review. In 5th Postgraduate Seminar on Natural Fiber Composites (28 Dec pp. 82–87). Serdang, Selangor: Universiti Putra Malaysia.

Ishak, M. R., Sapuan, S. M., Leman, Z., Rahman, M. Z. A., Anwar, U. M. K., & Siregar, J. P. (2013). Sugar palm (Arenga pinnata): Its fibres, polymers and composites. Carbohydrate Polymers, 91(2), 699–710.

Januar, P.S. (2005), *Tensile and Flexural Properties of Arenga Pinnata Filament (Ijuk Filament) Reinforced Epoxy Composites,* Master of Science Thesis, Universiti Putra Malaysia.

Jawaid, M., & Abdul Khalil, H. P. S. (2011). Cellulosic/synthetic fibre reinforced polymer hybrid composites: A review. Carbohydrate Polymers, 86(1), 1–18.

Mogea, J., Seibert, B., & Smits, W. (1991). Multipurpose palms: the sugar palm *(Arenga pinnata (Wurmb) Merr.)*. Agroforestry Systems, 13(2), 111–129.

Ridzwan, M.I. (2009), Mechanical Properties of Treated and Untreated Woven Sugar Palm Fibre-Reinforced Unsaturated Polyester Composites, Master of Science Thesis, Universiti Putra Malaysia.

Sahari, J. (2013), *Characterization and Development of Biopolymer Derived from Arenga Pinnata and their Biocomposites*, PhD Thesis, Universiti Putra Malaysia.

Sahari, J., Sapuan, S. M., Zainudin, E. S., & Maleque, M. A. (2013). Thermo-mechanical behaviors of thermoplastic starch derived from sugar palm tree (Arenga pinnata). Carbohydrate Polymers, 92(2), 1711–1716.

Sanyang, M. L., Sapuan, S. M., Jawaid, M., Ishak, M. R., & Sahari, J. (2016). Recent developments in sugar palm (Arenga pinnata) based biocomposites and their potential industrial applications: A review. Renewable and Sustainable Energy Reviews, 54, 533–549.

Sanyang, M.L. (2015), *Biodegradable Composite Films from Modified Sugar Palm (Arenga pinnata (Wurmb) Merr.)* Starch for Food Packaging Applications, PhD Thesis, Universiti Putra Malaysia.

Suriani, M.J. (2006), *A Case Study on Tensile Properties and Morphology of Arenga Pinnata Fiber Reinforced Epoxy Composites*, Master of Science, Universiti Putra Malaysia.

Zulkiflle, L. (2009), Mechanical Properties of Sugar Palm Fibre-Reinforced Epoxy Composites, PhD Thesis, Universiti Putra Malaysia.

Sugar Palm Fibers

Sugar palm starch (SPS) accumulates in the core of the stem of the sugar palm. Not all sugar palm trees yield sugar rich sap from the flower bunches. The non-productive palms can sometimes sum up to half the trees in a plantation. Starch is normally harvested from these unproductive trees following similar procedures as in the production of sago starch. The starch is extracted from the trunk of the sugar palm tree. It was reported that one sugar palm tree can yield 50–100 kg of starch. In the SPS extraction process, the sugar palm tree is brought down just before the first bloom and the trunk is split lengthwise to remove the woody fiber mixed with the starch powder from the inner soft core of the sugar palm trunk. This is followed by the washing process, where water was gradually introduced into the fiber and starch mixture and thoroughly kneaded by hand. The mixture is filtered to allow the water to flow through the sieve with starch granules in suspension. The starch is granted enough time to settle at the bottom of the container and the water is later decanted. Thereafter, the white powdered starch is kept in an open air for a moment and later dried in an air circulating oven at 120 °C for 24 h. Sahari et al. (2013) investigated the properties of SPS to explore their potential as a novel alternative polymer. SPS registered superior Amylose (37.60%) when compared to other starches such as tapioca (17%), sago (24–27%), potato (20–25%), wheat (26–27%) and maize (26–28%).

Sugar Palm Starch/Fibers as Reinforcement for Polymer Composites

Utilization of natural fibers with polymer matrices is essential for the mitigation of ecosystem devastation and provides low cost polymeric reinforced composites. The introduction of sugar palm fibers into polymer matrices further helps to address environmental problems associated with land filling of non-biodegradable conventional composites. In the past decade, a number of articles were published on sugar palm fiber reinforced polymers composites. Table 1 shows summary investigations on sugar palm fiber reinforced polymers composites.

Table 1: Summary of sugar palm fiber reinforced polymer composites research project at UPM

Researcher	Form of Fiber	Matrix	Process
Januar (2005)	Long Fiber	Epoxy	Hand lay-up
Suriani (2006)	Long Fiber	Epoxy	Hand lay-up
Bachtiar (2008)	Long Fiber	Epoxy	Hand lay-up
Zulkiflle (2009)	Long Fiber	Unsaturated polyester	Hand lay-up
Ridzwan (2009)	Long Fiber	Unsaturated polyester	Hand lay-up
Sahari (2011)	Frond, Bunch Fiber	Unsaturated polyester	Cold press
Sairizal (2011)	Long Fiber	Unsaturated polyester	Hand lay up
Ridzwan (2012)	Long Fiber	Unsaturated polyester	Cold press
Bachtiar (2012)	Short Fiber	Polystyrene	Compression molding
Hatim (2013)	Long Fiber	Thermoset	Cold press
Sahari (2013)	Ash	Sugar palm starch	Compression molding
Sanyang (2015)	Cellulose Fiber	Sugar palm starch	Solution casting
Ilyas (2017)	Nanocellulose Fiber	Sugar palm starch	Solution casting

Fiber Applications

Sugar palm fibers are extremely durable, even in contact with seawater. They possess good resistance to seawater and thus, use for making shipping ropes. A 12 ft (length) hybrid composite boat that was fabricated from the combination of sugar palm and glass fiber with unsaturated polyester as the matrix. In addition, a safety helmet was also developed from epoxy reinforced with sugar palm fiber. It is water resistant and could absorb and withstand high impact. The helmet was referred to as Helmet-Ijuk Reinforced Composite (HIReC). Besides, this strong fiber can

The most readily recognisable characteristics of Eucalyptus species are the distractive flowers and fruit (capsules or “gumnuts”). Flowers have numerous fluffy stamens which may be white, cream, yellow, pink, or red; in bud, the stamens are enclosed in a cap known as an operculum which is composed of the fused sepals or petals or both. Thus, flowers have no petals, but instead decorate themselves with the many showy stamens (Refer to Figure 2 for the Eucalyptus structure). As the stamens expand, the operculum is forced off, splitting away from the cup-like base of the flower; this is one of the features that unite the genus. The name Eucalyptus, from the Greek words eu-well and *kaluptos*-cover, meaning “well-covered”, describes the operculum. The woody fruits or capsules are roughly cone-shaped and have valves at the end which open to release the seeds, which are waxy, rod-shaped, about 1 mm in length, and yellow-brown in colour. Most species do not flower until adult foliage starts to appear; *E. cinerea* and *E. perriniana* are notable exceptions. Figure 3 shows the structure of the Eucalyptus fruits (Australian National Botanic Gardens, 2016).

Figure 2. Flowers of Eucalyptus
(Source: Australian National Botanic Gardens, 2006)

Figure 3: Fruits of Eucalyptus
(Source: Australian National Botanic Gardens, 2006)

The appearance of Eucalyptus bark varies with the age of the plant, the length of the bark fibres, the degree of furrowing, the thickness, the hardness and the colour. All mature Eucalyptus put on an annual layer of bark, which contributes to the increasing diameter of the stems. In some species, the outermost layer dies and is annually deciduous either in long strips (as in E. sheathiana) or in variably sized flakes *(E. diversicolor, E. cosmophylla or E. cladocalyx)*. These are the gums or smooth-barked species. The gum bark may be dull, shiny or satiny (as in E. ornata) or matte *(E. cosmophylla)*. In many species, the dead bark is retained. The outermost layer gradually fragments with weathering and sheds without altering the essentially rough-barked nature of the trunks or stems-for example *E. marginata, E. jacksonni, E. oblique and E. porosa.* Furthermore, many species are ‘half-barks’ or ‘blackbutts’ in which the dead bark is retained in the lower half of the trunks or stems – such as E. brachycalyx, *E. orhrophloia and E. occidentalis* – or only in a thick, black accumulation at the base as in *E. clelandii.*

In some species in this category for example *E. youngiana* and *E. viminalis* the rough basal bark is very ribbony at the top, where it gives way to smooth upper stems. The smooth upper bark of the half-barks and that of the completely smooth-barked trees and malless can produce remarkable colour and interest for instance *E. deglupta*. Figure 4 shows the structure of the Eucalyptus bark.

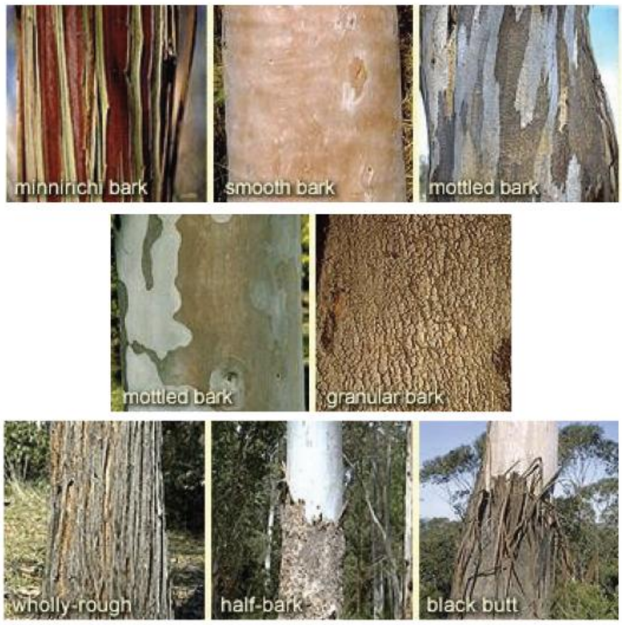


Figure 4: Bark of Eucalyptus
(Source: Australian National Botanic Gardens, 2006)

Eucalyptus plantations started in Australia in the 1980's to service the Eucalyptus oil industry. Due to its success, other countries such as Indonesia, China and the United States have initiated Eucalyptus growing programs. Nowadays, Eucalyptus tree plantations are valuable for timber, oil and biomass. Eucalyptus is currently present in over 90 countries and is spread over more than 22 million hectares worldwide, although only 13 million hectares have a productivity of interest from the industrial standpoint (Zalesny *et al.* 2011).

Eucalyptus began to be used in plantations outside its natural distribution area (Australia), over 200 years ago in Europe. In the United States, it was introduced in the mid-nineteenth century as a result of the migratory flow with New Zealand and Australia. Eucalyptus reached South Africa and Brazil in the late nineteenth century and in the early twentieth century. In South Africa, it was prompted by the demand for wood, needed for mining activities; in Brazil to produce the coal used in the steel industry.

Forest plantation is not a new concept and practice in Malaysia. Rubberwood and Acacia spp. are the two major species of the nine-selected species, other additional fast growing timber species promoted including *Tectona grandis, Azadirachta excelsa, Khaya spp., Neolamarckia cadamba, Falcataria moluccana, Octomeles sumatrana and Bamboo spp*. Recently Eucalyptus species has attracted the attention of the industry players particularly the plywood manufacturers, and investors in Malaysia.

Earlier attempts to plant Eucalyptus in Malaysia were in lowland area with 40 ha of Eucalyptus plantation as trial plots in 1931-1941 mainly with *Eucalyptus robusta*. In Sabah, a total of 7,000 ha were planted with *Eucalyptus deglupta* by Sabah Softwood Sdn. Bhd. and another 620 ha planted with *Eucalyptus grandis, E. urophylla, E. globulus and E. camaldulensis* by Sabah Forest Industries Sdn. Bhd. in 1991. Seeds from Australia, New Guinea, Indonesia and Sri Lanka have been used for plantations in Malaysia. Seeds from some of the older plantations have also been collected for further small scale plantation programmes (Appanah & Weinland, 1993). Most of the land used for plantation was logged-over forest, wasteland - consisting of mainly lalang grassland *(Imperata cylindrica)* and non-commercial secondary forests. These lands have been classified as 'not suitable' to 'marginally suitable' for agricultural use.

Forest plantations have been expanding yearly. In 2014, a total of 127,849 ha of forest plantation area in Peninsular Malaysia. However, in 2016, the number dropped to 113,503.99 ha. Table 3 shows forest plantation area in Sarawak while Table 4 shows in Sabah.

Table 1: Forest Plantation Area (ha) in Peninsular Malaysia by Species, 2008-2014

Year	2008	2009	2010	2011	2012	2013	2014
Acacia	55,503	59,486	74,438	28,978	41,989	46,126	34,258
Teak	2,698	2,709	2,709	2,901	2,847	2,847	2,847
Pine	2,667	2,667	716	374	374	374	374
Rubberwood	17,544	21,936	22,401	21,930	34,877	40,372	71,094
Azadiratha excelsa	281	281	281	881	868	868	875
Others	22,376	21,673	8,112	6,521	6,489	7,209	18,401
Total	101,069	108,752	108,657	61,585	87,444	97,796	127,849

Source: Forestry Department of Peninsular Malaysia (2015)

Table 2: Forest Plantation Development Area (ha) in Peninsular Malaysia, 2016

State	Forest Plantation area (ha)
Johor	36,212.88
Kedah	3,900.00
Kelantan	33,820.42
Melaka	-
Negeri Sembilan	1,197.38
Pahang	20,542.76
Perak	2,870.55
Perlis	671.00
Pulau Pinang	-
Selangor	11,381.00
Terengganu	2,908.00
Wilayah Persekutuan	-
Total	113,503.99

Source: Forestry Department of Peninsular Malaysia (2017)

Table 3: Forest Plantation Area (ha) in Sarawak by Species, 2008-2015

Major species planted	2008	2009	2010	2011	2012	2013	2014	2015
Acacia	168,517.48	192,339.02	193,047.02	214,180.82	221,089.08	227,635.49	236,936.24	239,748.50
Neolamarkia	30.90	17,442.51	17,442.51	18,849.47	19,913.04	20,420.96	21,762.02	21,951.24
Paraserianthes	16,254.00	22,603.17	22,603.17	29,993.04	38,104.34	42,546.60	48,485.62	51,625.56
Eucalyptus	**12,998.76**	**17,137.31**	**17,137.31**	**20,213.77**	**21,790.92**	**24,446.80**	**28,087.54**	**30,582.71**
Others	25,783.18	5,381.39	5,381.39	6,578.95	6,038.61	10,263.80	11,122.36	12,147.39
Total	**223,584.32**	**254,903.40**	**255,611.40**	**289,816.05**	**306,935.99**	**325,313.65**	**346,393.78**	**356,055.40**

Source: Forest Department Sarawak (2016)

Table 4: Forest Plantation Area (ha) in Sabah by Species, 2008-2016

Species/Year	2012	2013	2014	2015	2016 (as of October)
Acacia mangium	73,719.30	68,833.20	70,397.70	62,158.40	64,936.80
Acacia hybrid	-	1,003.00	1,672.00	1,266.00	1,266.00
Albizia falcataria	12,486.20	12,106.00	12,315.78	13,390.30	13,865.50
Gmelina arborea	782.70	754.30	754.30	130.90	152.70
Eucalyptus grandis	18,553.20	21,041.80	26,214.81	18,863.30	18,863.30
Eucalyptus pellita	-	-	-	7,884.60	7,884.60
Rubber	118,043.60	108,931.50	111,304.75	158,723.70	158,723.70
Teak	6,094.20	6,149.10	6,149.10	6,148.60	6,148.60
Binuang	1,472.40	1,450.10	1,077.00	1,190.00	1,077.00
Laran	3,269.60	2,912.30	2,824.80	2,936.40	3,218.60
Dipterocarpaceae spp.	5,011.40	7,087.00	8,410.00	8,410.00	8,410.00
Gaharu	142.70	121.00	121.00	70.00	70.00
Other species	9,463.30	8,779.70	3,431.70	6,080.50	5,789.50
Total	**239,112.40**	**239,169.00**	**244,673.00**	**287,252.70**	**290,406.30**

Source: Sabah Forestry Department (2017)

Planting of E. deglupta in Malaysia was stopped in 1982 due to poor performance when compared to other species (Sulaiman, 1996). Problems with insect and fungal pathogens are noted based on the historical background of this species in Malaysia. Thus, up to this date, most investors have a negative perspective towards this tree (Japarudin, 2016). Nevertheless, for the past several years Eucalyptus trees has been planted in some parts of Peninsular Malaysia, Sabah and Sarawak and the planted areas are growing. The sudden change of interest towards Eucalyptus may have arisen as a result of new interests by other countries, in particular China and Vietnam.

References

Anonymous (2016). Eucalyptus. In Wikipedia. Retrieved from:https://en.wikipedia.org/wiki/Eucalyptus

Appanah, S., Weinland, G. (1993). Planting Quality Timber Trees in Peninsular Malaysia. Malayan Forest Record No. 38. pp. 144.

Australian National Botanic Gardens. (2006). EUCLID. About Eucalypts. Learn about Retrieved from:https://www.anbg.gov.au/cpbr/cd-keys/euclid3/euclidsample/html/learn.htm#identification

Gahagan, B. (2010). Increasing Productivity in Brazilian Eucalyptus Plantation. Retrieved from: http://www4.ncsu.edu/~bggahaga/world_-forestry/

Japarudin, Y. (2016, March 21). Personal communication.

Sulaiman Salleh (1996). Eucalyptus Plantations: The Malaysian Experience. Reports submitted to the regional expert consultation on Eucalyptus. Volume II. RAP PUBLICATION: 1996/44. FAO.

Zalesny, R.S., Jr., Cunningham, M.W., Hall, R.B., Mirck, J., Rockwood, D.L., Stanturf, J.A. & Volk, T.A. (2011). Woody biomass from short rotation energy crops. In Sustainable Production of Fuels, Chemicals, and Fibers from Forest Biomass; ACS Symposium Series; Xu, J.Y., Pang, X.J., Eds.; American Chemical Society: Washington, DC, USA. pp. 27–63.

THE ECONOMICS OF BIOMASS WASTES TO BIOENERGY

Ong, C. L. [1] and Roda, J. M.[1]
[1]*Laboratory of Sustainable Bioresource Management, Institute of Tropical Forestry and Forest Products (INTROP), Universiti Putra Malaysia*

Introduction

Energy security has become a major challenge in human development in this era. Increasing energy demand, depletion of fossil resources, greenhouse gas emission and climate change bring complications to our environment and urges toward sustainable alternatives. One of the possible coping strategy is to develop renewable energy. Malaysia is blessed with tropical climate and fast-growing biomass. The biomass from crop residues can be used to generate biofuel without causing changes in land use, thus, avoiding competition with food. Many studies did show that Malaysia has good potentials to utilised biomass residues for biofuel. The estimated available biomass in Malaysia from agricultural and forest residues is up to 45.78 million dry tonne in year 2007, equivalent to 9.2 million ton of biofuel (Goh & Tan, 2010). Although biomass is seen as valorising wastes, it does not come with no cost. Biorefineries could aspect 33 to 50 percent of total production cost just for feedstock transportation (Kumar, Sokhansanj & Flynn, 2006). Even though biomass waste has low or no market value, the underlying natures of these resources have certain constraint to bioenergy industry.

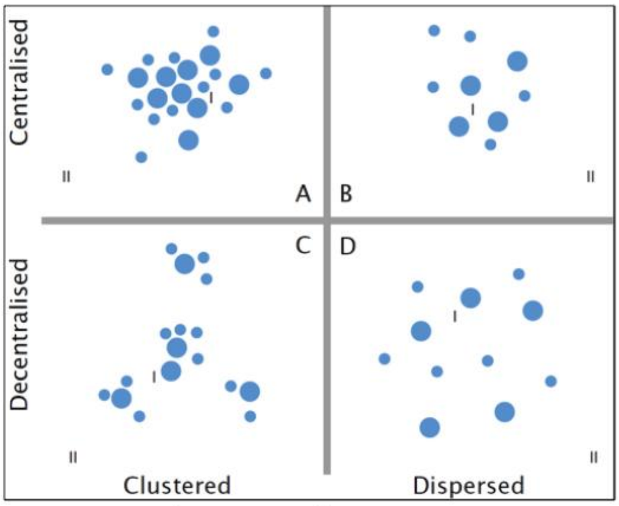


Figure 1. Spatial structure of biomass resources (Adapted from: Rodrigue, Comtois & Slack, 2013)

The Natures of Biomass Resources

The main factor that affects transportation cost of biomass is accessibility. The accessibility of each biomass is affected by its spatial diversity. As illustrated in Figure 1, it varies in terms of density and distribution. Depending on the location of the mill, the accessibility to the resource will differ greatly and will significantly impact the transportation cost. In each section of Figure 1, location I can access more biomass areas with less distances compare to location II. When more distances are required, the higher transportation cost would be incurred.

To evaluate the impact of biomass spatial structure, a GIS simulation was performed by computing distances of biomass from different potential biorefinery locations, using the road network within Peninsular Malaysia. The findings are illustrated in Figure 2. Each of the biomass source has its own best location. In each section, the optimal biorefinery location is able to minimise distance and maximise supply, as it requires less distance to access the biomass areas. For non-optimal biorefinery locations, more distance is required to access the same biomass areas. In Peninsular Malaysia, the forest logging residues and oil palm trunk spatial structure reflect the patterns from Figure 1A and 1B respectively. Their accessibility curves show that the areas of biomass sources follow a sigmoid shape. Rice straw structure is illustrated in Figure 1C. Its accessibility takes a staircase-liked curve. This is because areas of rice straw are clustered, with a lot of distance between the

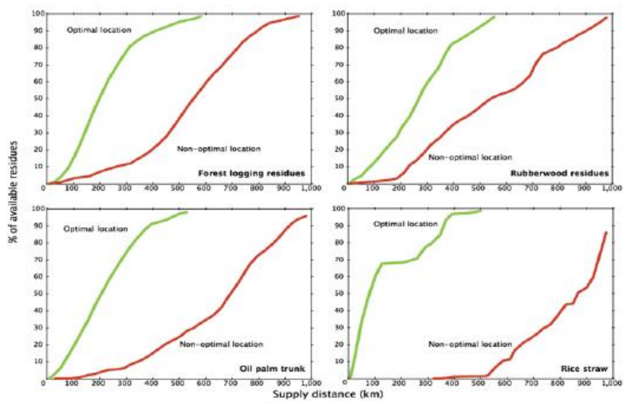


Figure 2. Accessibility of biomass residues in Peninsular Malaysia

different clusters. Rubberwood residues are geographically dispersed and are quite scattered. Thus, their accessibility graph increases steeply, suggesting that every area of rubberwood require a substantial amount of distance to reach.

A Paradigm Shift on Productivity

In conventional economic theory, when one increases the quantity produced, its marginal cost will diminish due to increased productivity. As shown in Figure 3, the unit cost decreases as the quantity increases up to its optimal point due to the scale effect. Unlike conventional economy of scale, the biorefinery is influenced by the nature of biomass resources. When the biorefinery increases its scale, the input required increases and more distances and cost would be incurred to acquire the biomass feedstock. Thus, the location of the mill is pivotal to the biorefinery's feasibility and sustainability, because it is the key to optimise the feedstock supplies and cost.

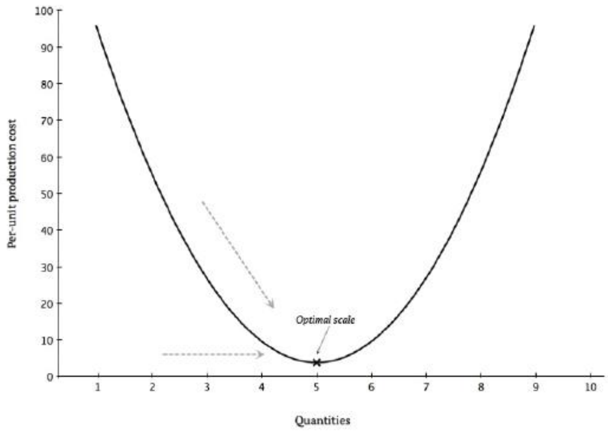


Figure 3. Conventional economy of scale

The following figures show the estimated unit production cost for biorefinery in Peninsular Malaysia, in the case of oil palm trunk and rice straw. For oil palm trunk at its optimal location, the spatial effect is larger than the scale effect as shown by the increasing per-unit production cost. However, when distance and supply are optimised, the cost escalates at a slow and steady rate. Conversely, the magnitude of increment for biomass supply distance to non-optimal location diminishes significantly the cost efficiency from scale effect, making the per-unit production cost increase quite steeply. In the case of rice straw, the cost of optimal location and non-optimal location differ significantly, due to substantial differences in supply distance and quantities. As illustrated, the situation for biorefineries is different than conventional economy of scale. To determine the feasibility, one way is to compare the market price and manage the production cost at a lower threshold. For example, if the market price is at fifty units, both non-optimal location would not be profitable. This also highlights the importance of location factor to the success of biorefinery.

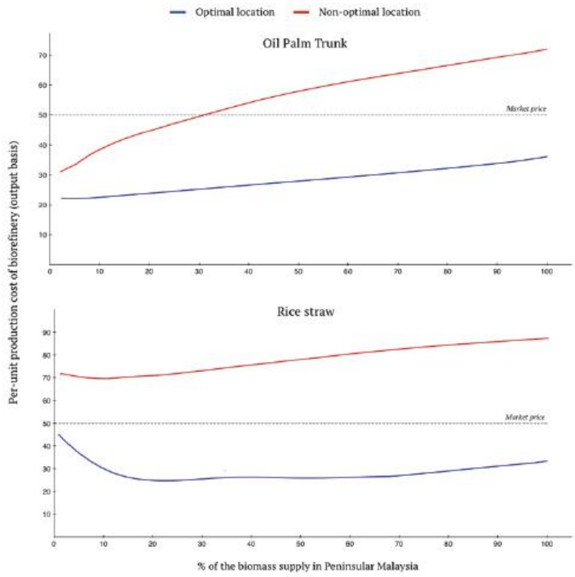


Figure 4. Estimated biorefinery production cost and biomass supply in Peninsular Malaysia

Way Forward

Today in Malaysia there is a notable potential to utilise abundant biomass residues for sustainable energy. However, there are two factors that have the most impact on biorefinery cost. One is the conversion efficiency and another is the changes in biomass spatial structure and transportation distance (Gan & Smith, 2010). With technology advancement, conversion technology could reduce its cost by improving the productivity and yields. Nevertheless, the biomass geography affects the biorefinery externally and such factor has a major importance. Fortunately, this factor can be assessed through modelling and simulations. It is important to consider the distinct dynamics of bioenergy industry for decision making and policy formulation. This could minimise the difficulty in developing alternative energy for our sustainable future.

Acknowledgement

The authors would like to express sincere gratitude on supports from the consortium of Aerospace Malaysia Innovation Centre, Airbus SAS, French Agricultural Research Centre for International Development (CIRAD) and University Putra Malaysia, with funds provided under the project "Centre of Excellence on Biomass Valorization for Aviation", Grant no. 6300142 and 9300428.

References

Gan, J., & Smith, C. T. (2010). Optimal plant size and feedstock supply radius: A modeling approach to minimize bioenergy production costs. Biomass and Bioenergy, 35(8), 3350–3359. http://doi.org/10.1016/j.biombioe.2010.08.062

Goh, C. S., Tan, K. T., Lee, K. T., & Bhatia, S. (2010). Bio-ethanol from lignocellulose: status, perspectives and challenges in Malaysia. Bioresource Technology, 101(13), 4834-4841.

Kumar, A., Sokhansanj, S., & Flynn, P. C. (2006). Development of a multicriteria assessment model for ranking biomass feedstock collection and transportation systems. Applied Biochemistry and Biotechnology, 129(1), 71-87.

Rodrigue, J. P., Comtois, C., & Slack, B. (2013). The geography of transport systems. Routledge.

A REVIEW ON THE EU COUNTRIES' BIO-ECONOMY STRATEGIES: CASE ON MALAYSIAN INDUSTRIES

Norfaryanti Kamaruddin[1]
[1]Laboratory of Sustainable Bioresource Management, Institute of Tropical Forestry and Forest Products (INTROP), Universiti Putra Malaysia

Introduction

"A bioeconomy can be seen as a world where biotechnology contributes to a significant share of economic output. It involves; the use of advance knowledge of genes and complex cell processes to develop new processes and products; the use of renewable biomass and efficient bioprocesses to support sustainable production; and the integration of biotechnology knowledge and applications across sectors. The bioeconomy offers technological solutions for the many challenges facing the world, but achieving its potential will require appropriate national, regional, and global policies." The Organization for Economic Co-operation and Development (OECD), 2009.

In response to (OECD) agenda, in 2012, the European Commission presented a comprehensive proposal to address the challenges faced by the world due to the ecological, environmental, energy, food supply and natural resources. They established a bio-economy term which reflects an economy where the production of food, feed, fibre, bio-based products and bio-energy employ efficiently and sustainably using renewable resources from land, fisheries, and aquaculture environments. The efficient and sustainable production ecosystems satisfy industry demand, consumers' needs and environmental challenges (van de Pas, 2015).

There are some EU Member countries which have low levels of adaptation in strategic planning towards bioeconomy activities and its value chain. The objective of the study is to map the intended priorities and activities of EU members regarding research & innovation (R&I) on bioeconomy according to the current Smart Specialisation Strategies. This is to assist in understanding the similarities, commonalities and specificities among the EU member countries and to further analyse their gaps.

On the other hand, Malaysia developed a National Biotechnology Policy in 2005, and 7 years after, comes the Bioeconomy Transformation Program strategy. It is reaching newer heights in developing Malaysia in the bioeconomy driven nation.

This strategy development is aligned with the global agenda, but the Malaysia's current status of meeting the milestone in the strategy is not clear. In understanding the current position, it is good to understand the development status of other developed nations. This paper is to review the status of bioeconomy strategies among the EU country members, and based on this, Malaysia could better strategize its position in driving towards a bioeconomy nation. There are various Malaysia bioeconomy reports published by Bioeconomy Corporation, but for this article, only Bioeconomy Malaysia Report: Towards a Bioeconomy Nation: Rethinking Industries was referred.

Since Malaysia is a nation with rich in natural resources which could drive further the bioeconomy strategy. In 2016, about 19000 bio-based companies in Malaysia who generating up to RM 430 billion per year in revenue. The size of the bioeconomy industry in Malaysia is RM 142 billion, where 75% consisting of upstream agriculture activities (oil palm cultivation, rubber plantation, livestock, forestry and fishing). Meanwhile, 25% is consists of downstream sectors (oil & fats, beverages, renewable fuel, wood products, organic, chemicals, and food processing).

EU Experiences in Developing Bioeconomy Strategies

Thematic variations

Based on the document analysis, 98.6% of the European countries and regions include bioeconomy in their research & innovation priorities and plans. However, there are variations in the denomination of the bioeconomy aspects. The variations are among, low-carbon, green growth, sustainable agriculture, innovative food production, green chemistry, eco-innovation, and circular economy to blue growth. There is also thematic variations within the countries and regions, for example, agro-food, bio-based fuel and energy, and other bio-based industry.

Among the themes, there could be seven different areas of bioeconomy projects which could be further developed specifically: knowledge generation; knowledge transfer, engagement, stakeholder network; new generation and re-definition of value chains and value cycles/demonstration/technological readiness; public awareness, dissemination of information; bioeconomy coordination, governance and platforms; education; and learning from other regions, alliances.

Value chain analysis

Understanding bioeconomy in the perspective of value chain analysis is prominent approach in Europe. It involved value chains of biomass supply over biomass processing up to the production of bio-energy and innovative bio-based products. Bio-energy and fuel from biomass, and food and beverages, were the two most frequent specific value chain approaches. Malaysia is carrying out measures to map a complete value chain from the upstream to the commercialisation in the R&D elements.

IN EU experience, there is a wide variety in knowledge and expertise needed for different bioeconomy activities. There is no general territorial pattern for specific bioeconomy aspect in the R&I. Agro-food is the broad theme that frequently ranked first in the strategic plans. Regions involved is in Portugal, Spain, North-West France, Northern Germany, Sweden, Latvia, Lithuania, Czech, Slovakia, Hungary, Romania, Bulgaria, Greece, Croatia, Slovenia, and Italy.

Theme bio-based fuels and bioenergy covered territories in Southern France, Southern Germany and Southern Poland, Southern and Central Finland, Scotland, Ireland, and Galicia (Spain). Other bio-based industries including biorefinery, biochemicals, and biopharmaceuticals is found in Estonia, regions in France, Austria, England, Poland, Belgium and The Netherlands.

Bioeconomy maturity index and Distribution by countries/states

Bioeconomy R&I maturity index among EU countries were calculated as to rank the overall innovation capacity of a territory, the extent of existence of specific bioeconomy features. Regions and countries with high bioeconomy maturity index represent 5% of the EU, they are Sweden, Finland, England, Austria, Flemish Region in Belgium, Central Jutland in Denmark, Southern Netherlands, parts in Germany. There are 46% regions with middle-high maturity, 23% middle maturity, and 36% low maturity.

Currently, information on Malaysia maturity index is unavailable. It is important to obtain the similar index for Malaysia to further understand the current situation in aligning the strategies towards bioeconomy. This is the gap where researchers or agencies could take to provide more insights in Malaysia's status towards bioeconomy.

As of today, Malaysia analysed the distribution of bioeconomy industries on the state basis. Figure 1 shows the sectoral contribution in the bioeconomy based on the number of companies involved in the bieconomy related activities.

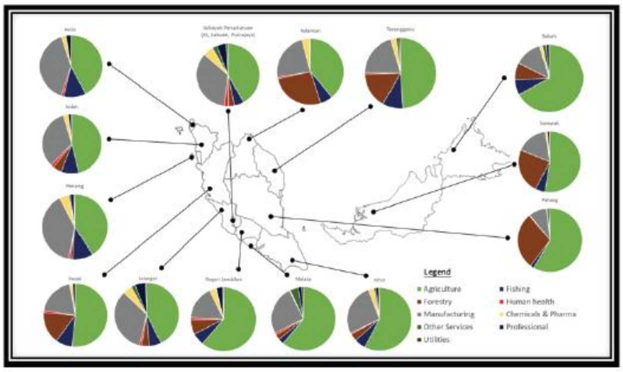


Figure 1: Malaysia bioeconomy sectoral contribution by states
(Source: Bioeconomy Malaysia Report, 2017)

Bioeconomy drivers, external factors and supports

There is a wide array of drivers of the bioeconomy. Different drivers have important influence on how the bioeconomy is implemented (i.e, resource driven, value-chain driven, business driven, or knowledge driven). In most cases, the driver is in the regional assets and resources which makes it supply-side driven.

There is an external factor that drive and stimulate the bioeconomy activities. Political decisions can increase competitiveness and promote economic development activities specifically within the theme of the bioeconomy. It can also be a response to the environmental and territorial challenges (i.e, loss of population in rural areas, and climate change).

There are 19 Member states have strategic approach in supporting bioeconomy with having bioeconomy strategy or in process of developing it. For others which do not have explicit bioeconomy strategy, it supported do not have explicit bioeconomy strategy, it supported in embedded in several strategic documents or funding programs. It includes, national and regional R&I strategies and plans, sectoral inoovation strategies and plans (innovation in agriculture, fisheries, and waste management).

The stakeholders and clusters

Regional bioeconomy ecosystems in Europe involved usual stakeholders: Governments and public administration, businesses, sectoral associations and business intermediaries, acadmic and scientific and technological institutions.

Clusters are important tool to gather stakeholders around specific bioeconomy sectors. Bioeconomy related clusters need to be integrated between, producers of biological resources (Farmers, fishermen, and their association), and among the government coordinators in various policy areas (R&I, agriculture, environment).

Intermediaries organisations are important as many technologies are immature and inter sectoral cooperation is important. Bioeconomy does not always has its own actors. There is lacking of specific bioeconomy bodies and network and limit the development of organised bioecionomy areas. Among the specific and emergent stakeholders are; Bioeconomy Strategy Council, Specialised Technology, Research and Innovation Centers, operational cooperation agencies, and cross-border and interregional cooperation project.

Financial sources

About 67% of the regions intend to use European Structural and Investments Funds (ESIF) as a funding source to support their bioeconomy activities. The analysis showed European countries and regions also use variety of other EU programs to support bioeconomy promotion, such as, Interreg, LIFE+, CIP/COSME, ERASMUS+, and Intelligent Energy Europe.

Conclusion

In response to EU experiences in positioning their regional strategies, there are needs and bottlenecks to manage in relation to; strategic planning and governance; value chain/cycle development; R&I on technologies, knowledge transfer, education and new bioeconomy skills; funding and synergies between instruments; public awareness and acceptance; and external factors. These challenges are global challenges which Malaysia could be better prepared in overcoming it.

To conclude, 36% of the EU regions have low maturity level in bioeconomy activities and support. Therefore, further development are needed in few areas; common definition/classification of bioeconomy; coordinated support between the higher maturity regions and low maturity regions in strategic planning, communication, and knowledge transfer; leadership in coordinating, aligning, and combining the efforts on R&I to engage stakeholders; more specialised support in different bioeconomy maturity and profiles; support on developing the transdisciplinary and specific bioeconomy competences and skills; better access to finance; and activities to raise public awareness and acceptance towards bioeconomy.

Similar to Malaysia as a country, there are states that have low capacity and support in achieving the national bioeconomy goals. These findings should be embraced and able to be better equipped in implementing bioeconomy strategies at the local level.

References

Spatial Foresight, SWECO, ÖIR, t33, Nordregio, Berman Group, Infyde (2017). Bioeconomy development in EU regions. Mapping of EU Member States'/regions' Research and Innovation plans & Strategies for Smart Specialisation (RIS3) on Bioeconomy for 2014-2020.

The Organisation for Economic Co-operation and Development (OECD) (2009). The Bioeconomy to 2030: Designing a policy agenda. Main findings and policy conclusions. OECD International Futures Projects.

Bioeconomy Corporation (2017). Towards a Bioeconomy Nation: Rethinking Industries. Bioeconomy Malaysia Report.

URBAN FORESTS, MICROCLIMATE AND HUMAN THERMAL COMFORT: A PATHWAY FOR BIOECONOMY STRATEGY

Ruzana Sanusi[1, 2]
[1]*Faculty of Forestry, Universiti Putra Malaysia*
[2]*Laboratory of Sustainable Bioresource Management, Institute of Tropical Forestry and Forest Products (INTROP), Universiti Putra Malaysia*

Introduction

The concept of bioeconomy is to grow and increase the needs for natural resources which leads to Land Use and Cover Change (LUCC) hence pressures on the ecosystem services, soil and water resources. Overcoming these situations is important through implementation of possible pathways that contributes to bioeconomy sustainability. One of the key drivers for green economy strategy is the need for improvement in sustainable resource management (Rosegrant et al., 2012). In relation to sustainable resource management, urban forests, climate change mitigation and human health are some of the important indicators relevant for bioeconomy strategy (Wolfslehner et al., 2016).

Figure 1: Street trees and green roof garden as part of urban forest

Long-term provision of urban forest benefits is essential in supporting this strategy. Sustainably managed urban forests can provide important environmental and social values and ecosystem services such as microclimate benefits that contributes to climate change mitigation and improve human health issues for urban residents such as human thermal comfort. These benefits can direct and indirectly influences bioeconomy through several ways such as energy saving from the cooling effect of urban forest and, public health cost saving from decrease heat related health risk especially during extreme weather events (i.e heat waves) (Sun et al., 2017; Salata et al., 2017). Therefore, in order to facilitate sustainable urban forest resource management as a pathway in bioeconomy strategy, assessment of the microclimate and human thermal comfort benefits from urban forest is important as this can determine how the urban planners and managers can manage and improve the urban forest.

Figure 2: Taman Saujana Hijau is one of the urban parks in Malaysia

Methods Applied for Microclimate and Human Thermal Comfort Assessments

Besides natural forest in urban areas, trees located at streets, parks, green roof utility and transportation corridors are also considered as urban forests where these places are usually used in the microclimate and human thermal comfort assessments (Figure 1 and Figure 2). The parameters measured in microclimate assessment are listed as wind speed, air temperature, relative humidity and solar radiation. Based on these measurements, microclimate benefits of urban forest can be obtained by comparing the microclimate conditions in the areas with green vegetation such as trees and away from it (Wang et al. 2015; Nice et al., 2018).

Figure 3: Microclimate and human thermal comfort assessments in an urban park

For human thermal comfort assessment, direct estimation of human thermal comfort and human thermal comfort perception can be done. In order to estimate the human thermal comfort, microclimate parameters for microclimate assessment are needed (Figure 3). It is also necessary to include Mean Radiant Temperature measurement (T_{mrt}), which is the measurement of mean temperature from all sources of radiation surrounding human body includes direct sunlight, shortwave and longwave radiation, and reflected radiation in all directions (Fanger, 1970). T_{mrt} can be measured using black hollowed globe with a temperature sensor (Nikolopoulou et al., 1999; Sanusi et al., 2016). The human thermal index can be estimated by using Physiologically Equivalent Temperature (PET) and Universal Thermal Climate Index (UTCI) (Mayer and Höppe 1987; Błażejczyk, 2010). On the other hand, human thermal comfort perception can be assessed by preparing a perception survey where relevant information such as visitor's demographic background, perception and preference of current thermal and shading conditions, clothing, activities and purpose of visit can be gained (Lam et al., 2018).

Conclusion

The existence of urban forest has great impact on environment and residents. Related to that, information on microclimate and human thermal comfort benefits that provided by urban forests is very important in terms of designing, planning and managing the urban forest landscape. In addition, the benefits may contribute towards sustainable urban forest resource management which should be highlighted as value-added goals for the development of sustainable bioeconomic .

References

Błażejczyk, K., Broede, P., Fiala, D., Havenith, G., Holmér, I., Jendritzky, G., Kampmann, B. & Kunert, A. (2010). Principles of the new Universal Thermal Climate Index (UTCI) and its application to bioclimatic research in European scale. Miscellanea Geographica, 14(2010), 91-102.

Fanger, P.O. 1970. Thermal comfort: Analysis and applications in environmental engineering. Danish Technical Press, Copenhagen, Denmark.

Lam, C. K. C., Loughnan, M., & Tapper, N. (2018). Visitors' perception of thermal comfort during extreme heat events at the Royal Botanic Garden Melbourne. International journal of biometeorology, 62(1), 97-112.

Mayer, H., & Höppe, P. (1987). Thermal comfort of man in different urban environments. Theoretical and applied climatology, 38(1), 43-49.

Nice, K. A., Coutts, A. M., & Tapper, N. J. (2018). Development of the VTUF-3D v1. 0 urban micro-climate model to support assessment of urban vegetation influences on human thermal comfort. Urban Climate.

Nikolopoulou, M., Baker, N., & Steemers, K. (1999). Improvements to the globe thermometer for outdoor use. Architectural Science Review, 42(1), 27-34.

Rosegrant M.W., Ringler C., Zhu T., Tokgoz S., Bhandary P. 2012- Water and food in the bioeconomy: challenges and opportunities for development. Agricultural Economics 44 (1): 139-150.

Salata, F., Golasi, I., Petitti, D., de Lieto Vollaro, E., Coppi, M., & de Lieto Vollaro, A. (2017). Relating microclimate, human thermal comfort and health during heat waves: An analysis of heat island mitigation strategies through a case study in an urban outdoor environment. Sustainable cities and society, 30, 79-96.

Sanusi, R., Johnstone, D., May, P., & Livesley, S. J. (2017). Microclimate benefits that different street tree species provide to sidewalk pedestrians relate to differences in Plant Area Index. Landscape and Urban Planning, 157, 502-511.

Xu, X., Sun, S., Liu, W., García, E. H., He, L., Cai, Q., Xu, S. Wang, J. & Zhu, J. (2017). The cooling and energy saving effect of landscape design parameters of urban park in summer: A case of Beijing, China. Energy and Buildings, 149, 91-100.

Wang, Y., Bakker, F., de Groot, R., Wortche H. & Leemans, R. (2015). Effects of urban trees on local outdoor microclimate: synthesizing field measurements by numerical modelling. Urban Ecosystem 18: 1305-1331.

Wolfslehner, B., Linser, S., Pülzl, H., Bastrup-Birk, A., Camia, A., & Marchetti, M. (2016). Forest bioeconomy–a new scope for sustainability indicators. From Science to Policy, 4. European Forest Institute.

IDENTIFICATION OF INSECT PESTS OF KENAF *(Hibiscus cannabinus L.)* AT LADANG PUCHONG, TAMAN PERTANIAN UNIVERSITI, UPM

Rozihawati, Z.[1], Sheriza, M. R.[1], Zaiton, S.[1,2], Mohd Hambali, M. J.[1], Norisyam, A. R.[3]
[1]*Laboratory of Sustainable Bioresource Management, Institute of Tropical Forestry and Forest Products (INTROP), Universiti Putra Malaysia*
[2]*Faculty of Economics and Management, Universiti Putra Malaysia*
[3]*Department of Forest Management, Faculty of Forestry, Universiti Putra Malaysia*

Introduction

Hibiscus cannabinus L. or kenaf belongs to the Malvaceae family. It is similar with Hibiscus genus with cotton, bend and roselle plants. H. *cannabinus* is commercial species grown in China, Myanmar, India, Bangladesh, Thailand and Malaysia. In Malaysia, total area of kenaf planting is about 328,600 km2 and the area including Peninsular Malaysia is 131,600 km^2, Sabah is 73700 km^2 and Sarawak is 123,300 km^2 (EAPAP, 1994 in Basri et al., 2014). The kenaf was planted in Malaysia because it is a short-day crop, which can harvest from plantation within 3 to 4 months. It also can grow in this country with have suitable of temperature climates, thrives with abundant solar radiation and high rainfall. It is also an important species due to global environmental issues and inadequate raw fibre resources. Scientists have developed more important potential economic and environmental benefits of the utilization of kenaf in the areas of soil remediation, reduced soil erosion due to wind and water, toxic waste clean-up, removal of oil spills on water, replacement or reduced use on fibre glass in industrial products, the increased use of recycled plastics reduced chemical and

Figure 1. Kenaf planting areas in Peninsular Malaysia *(sources: LKTN, 2017)*

However, kenaf also been attacked by pests, as recorded by Aminah et al. (2006) and Wong et al. (2001) that some of the pests of kenaf can damage young shoots, flower buds and developing fruits. Moreover, nematodes are an important pest which can inhibit the growth of the plant, especially effect on fibre quality (Daud, 2006). Due to this, spray application of furadan was used for controlling the nematodes (Daud, 2006). Kenaf has been attacked by pests such as Dysderus cingulatus and Aphis gossypii also recorded by Basri et al. (2014). Thus, we need to observe and record the pests and diseases in order to ensure good growth performance and fibre quality of the kenaf.

Kenaf Planting at Taman Pertanian Universiti

27 varieties of kenaf seeds were planted in Ladang Puchong on 16th May 2017, Taman Pertanian Universiti (TPU), Universiti Putra Malaysia. The experiment was conducted using a line planting method with the distance between of the plant is 30cm x 30cm. The crops were treated with NPK green after sowing and NPK blue a month after sowing. Chemical pesticide such as malathion and herbicide (Basta 15) were also applied on the crops 2 times, which applied a month after sowing and 2 months after sowing, whereas plot area with no pesticide was used as a control. In this study, the pests and diseases of the kenaf varieties were observed and recorded. The pests of kenaf were collected and identified in laboratory based on physical insect characteristics. The insect damage percentage of kenaf varieties were also recorded in the site.

Results and Discussions

The results showed that most of the kenaf variety at four-month old of control treatment (without pesticide) show serious attacked by insect. For example, Hibiscus flea beetle (Nisotra sp.) was seriously attacked on the plant as shown in Figure 2. However, no insect pest recorded of the kenaf plants treated with chemical pesticide.

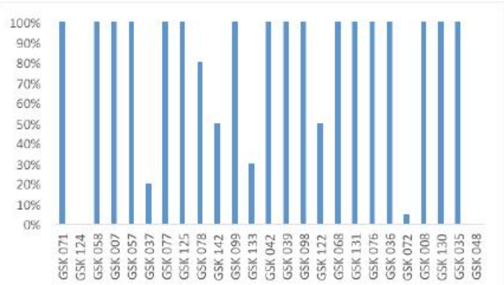


Figure 2. Insect damage percentage of the kenaf varieties at four-month old of control treatment (without pesticide) in TPU plantation.

Table 1. Insect pest of kenaf

Insect pest	Symptoms	Larva, nimfa and adult
Hibiscus flea beetle (*Nisotra* sp.)	Eating young and old leaves also flower, that causes reduction inthe number of leaves that interfere with the growth process of the tree.	
Corton leaf roler *(Haritalodes derogate)*	Eating young leaves and leaves will be curled. Often it will cause a reduction in the number of leaves that interfere with the growth process of the tree.	 
Caterpillar *(Amata nigriceps)*	Eating young and old leaves leads to a reduction in the number of leaves that interfere with the growth process of the tree	 
Kepinding *(Dysdercus cingulatus)*	Suck the leaf fluid by using a sharp portion of her mouth to puncture the hole. The leaves will be twitching or twitching effect of the crumbling activity.	

Most of these varieties were attacked by *Nisotra* sp. except kenaf variety of GSK 124 and GSK 048. The effect of this insect pest also resulted in the alteration of the photosynthesis process for the plant growth (Haimidin Kadir, 2012). However, possibility the strong kenaf variety from attack by *Nisotra* sp., due to chemical content in the plant. The bioactivity of insecticide compounds presents in some of the plants such as coumarin compound, can against Coleoptera pests (Moreira et al., 2007). Phytochemicals from the plant offer not only effective control agents, but also are biorational alternatives to organic synthetic pesticides (Sukumar et al. 1991). Besides, the phytochemicals from the plant active act as antifungal, for example alkaloids,phenolics, flavonoids, terpenoids, benzofurans, essential oil, and coumarins is normally used by researchers (Venugopala et al., 2013). The insect pests of kenaf plants were recorded in this study are shown in Table 1.

To obtain the quality yield and fiber, chemical pesticide such malathion and furadan was used for controlling the insect pests. However, the chemical pesticide application causes negative effects on human and environment (Lee at al., 2007). One alternative to the pesticide for pest control that receives attention is organic pesticide containing plant-derivative chemicals (Benner, 1993). It is good reason to protect them from attack by insect pests.

Conclusion

In conclusion, most of the kenaf varieties is serious attacked by beetle such as Hibiscus flea beetle (Nisotra sp.), except kenaf variety of GSK 124 and GSK 048. The organic pesticide should be use for controlling the pests and diseases of the kenaf crops in plantation. It is a good reason to promote the good quality of the environment.

References

Aminah, A., Wong, C.C. and Hasim, I. 2006. Production potential of kenaf for forage and fiber on bris under smallholder production system. In: Fourth technical review meeting on the National Kenaf Research Project, MARDI, pp. 15-20

Basri, M. H. A., Arifin, A., Nasima, J., Hazandy, A H. and Khalil, A. 2014. Journey of kenaf in Malaysia: A Review. Scientific Research and Essays 9(11): 458-470.

Benner, J.P. 1993. Pesticidal compounds from higher plants. Pesticide science 39: 95 – 102.

Daud, M.D.M. 2006. Development of kenaf production in Malaysia. In: Fourth technical review meeting on the National Kenaf Research project. MARDI, pp. 119-130.

Hailmi, M.S. and Kadir, J., 2012. Penyakit Tanaman Industri. Universiti Sultan Zainal Abidin, Kuala Terengaanu. 179 p.

Lee, S.O., Choi, G.J., Jang, K.S. and Kim, J.C. 2007. Antifungal Activity of five plant essential oils as fumigant against postharvest and soilborne plant pathogenic fungi. Plant Patho J, 23: 97-102.

Lembaga Kenaf dan Tembakau Negara, 2011. Buletin LKTN. Lembaga Kenaf danTembakau Negara.

Marcio, D.M., Marcelo, C. P., Luiz, C. A. B., Raul Narciso, C. G., Mateus R. C., Gerson, A. S. and Julio, C. M., 2007. Plant compounds insecticide activity against Coleoptera pests of stored products. Pesq. Agropec. Bras., Brasilia, 42 (7): 909-915

Sukumar K, Perich MJ, and Boobar LR. 1991. Botanical derivatives in mosquito control: a review. J Am Mosq Control Assoc 7:210–237.

Venugopala, K. N., Rashmi, V., and Odhav, B. 2013. Review Article Review on Natural Coumarin Lead Compounds for Their Pharmacological Activity. BioMed Research International, 963248 1 : 1–14.

Webber, C. L., Bhardwaj, H. L. and Bledsoe, V. K. 2002. Kenaf Production: Fibre, Feed and Seed. In: Janick, J., A. Whipkey (Eds.), Trends in new crops and new uses. ASHS Press, Alexandria, VA, pp: 327-339.

Wong, C.C., Nizam, A.M., Vijaysegaran, S., Mah S.Y. and Ghawas, M. 2001. Kenaf germplasm introductions and assessment of their adaptability in Malaysia for forage production. In: First technical review meeting on the National Kenaf Research project. MARDI, pp. 13-24.

MODIS SATELLITE LAUNCHED FOR LAND RESOURCES MAPPING

Sheriza M. R.[1] and Nurul F. M.[1]
[1]Laboratory of Sustainable Bioresource Management, Institute of Tropical Forestry and Forest Products (INTROP), Universiti Putra Malaysia

Introduction

Moderate Resolution of Spectro radiometer (MODIS) is a satellite with a cross-track scanner (whiskbroom) that makes observations on the Earth in 36 spectral bands. MODIS scan wavelengths from 0.41 to 14.41 µm (X. Xiong *et al.*, 2009).The satellite is capable to capture data in these bands simultaneously with various temporal resolutions, for examples: 1-day, 8-day, and 16-day intervals. The satellite was designed with three spatial resolutions of 250 m, 500 m and 1 km with a wide field of view (FOV).

The first MODIS was launched in December 1999 on the polar orbiting NASA Earth Observation System (EOS) Terra satellite. The second one was launched on the polar orbiting Aqua satellite on May 2002 (Fensholt & Sandholt, 2003). The Terra and Aqua were built with special attention paid to the structure's thermal sensitivity and the mechanical isolation of the instruments and spacecraft components. This makes the satellite is more relevant for multipurpose forest canopy and surface research that recent and previously reported (Biudes *et al.*, 2014; Fensholt & Sandholt, 2003).

MODIS produced multi land and ocean products that can be used for scientific climate assessment for terrestrial, regional and local. The products are divided into three overall families, namely, radiation budget variables, ecosystem variables and land cover characteristics Xiaoxiong Xiong *et al.* (2006) (Table 1.0). We presented only MOD09 and MOD12Q product here because they are frequently applied for various studies.

Table 1. MODIS data products and characteristics (Qu, Gao, Kafatos, Murphy, & Salomonson, 2006)

Products code	Products broad name	Spatial Resolution	Temporal resolution/ Frequency
MOD09	Surface Reflectance	250 m, 500 m, 1 km	1-day, 8-day
MOD11	Surface Temperature and Emissivity	1 km	5-min, 1-day, monthly
MOD43	BRDF/Albedo	1 km	16-day
MOD10	Snow Cover	500 m	5 min, 1-day, 8-day
MOD29	Sea Ice extent	500 m	5 min, 1-day
MOD13	Vegetation indices	1 km, 500 m, 250 m	16-day
MOD15	LAI and FPAR	1 km	8-day
MOD17	GPP and NPP	1 km	8-day, 1 year
MOD12	Land cover type and Vegetation Dynamics	500 m, 1 km	1-year
MOD14	Thermal Anomalies and Fire	1 km	5-min, 1-day, 8-day
MOD44	VCC and VCF	500 m, 250 m	96-day, 1 year

In general, each MODIS image or product came with a unique code, whereby represented their product short name, data of acquisition, collection and etc. An example of the code is shown in the Table 2.0 below.

Table 2. MODIS data unique codes and full description, based on the example given.

MOD09A1.A2006001.h08v05.005.2006012234657.hdf	
	Description
MOD09A1	Product Short Name
A2006001	Julian Date of Acquisition (A-YYYYDDD)
.h08v05	Tile Identifier (horizontalXXverticalYY)
.005	Collection Version
.2006012234567	Julian Date of Production (YYYYDDDHHMMSS)
.hdf	Data Format (HDF-EOS)

MOD09

MODIS Surface Reflectance product (MOD09) is available in two spatial resolutions: MOD09A1 is for 500 m and MOD09A2 is for 1 km resolution. The products were used for estimating Net Primary Production (NPP) and Gross Primary Production products (MODIS Gross GPP/NPP) based on Light Use Efficiency models. In the incoming section, MODIS GPP/NPP will be known as MOD17. MOD09A1 captured images by 8-day intervals and carries seven spectral bands (Table 3.0).

Table 3. MODIS spectral properties.

Band	Colour	Wavelengths (nm)	Typical use
band 1	Blue	(459–479 nm	Vegetation
band 2	Green	545–565 nm	Soil
band 3	Red	620–670 nm	Vegetation
band 4	Near infrared	841–875 nm	
band 5	Near infrared	1230–1250 nm	Water detection
band 6	Shortwave infrared	1628–1652 nm	Snow
band 7	Shortwave infrared	2105–2155 nm	Snow

MOD09A1 is a good source for development of vegetation index, especial The Normalized Vegetation index (NDVI) that was employed in many studies (Caccamo *et al.*, 2011; Sheldon *et al.*, 2012).

MOD12Q

MODIS Land Cover products (MOD12Q) are images of current state and seasonal-to-decadal scale dynamics of global land cover properties (Friedl et al., 2010). MOD12Q has two products: MODIS Land Cover Type (MLCT) (MOD12Q1) and Land Cover Dynamics (MOD12Q2) that include five and seven land cover layers, respectively. Hereafter, we refer MOD12Q1 as MLCT products. In this study, we discussed MLCT only because we employed the products for our study.

Table 4. The classification of land cover included in MLCT (Hansen *et al.* 2003).

	IGBP	UMD	LAI/FPAR	BGC	PFT
Forest	Evergreen needle leaf forest	Evergreen needle leaf forest	Evergreen needle leaf forest	Evergreen needle leaf vegetation	Evergreen needle leaf tree
	Deciduous needle leaf forest	Deciduous needle leaf forest	Deciduous needle leaf forest	Deciduous needle leaf vegetation	Needle leaf deciduous tree
	Evergreen needle leaf forest	Evergreen needle leaf forest	Evergreen broadleaf forest	Evergreen needle leaf vegetation	Broadleaf evergreen tree
	Deciduous needle leaf forest	Deciduous needle leaf forest	Deciduous broadleaf forest	Deciduous broadleaf vegetation	Broadleaf deciduous tree
	Mixed forests	Mixed forests			
Woodlands	Woody savannah	Woody savannah	Savannah		
	Savannah	Savannah			
Grasses/ Cereals	Grasslands	Grassland	Grasses/Cereal crops	Annual grass vegetation	Grass
Shrublands	Closed shrublands Open shrublands	Closed shrublands Closed shrublands	Shurblands Shurblands	Annual grass vegetation	Shrub Shrub
Croplands and mosaics	Croplands	Croplands	Broadleaf crops	Annual broadleaf vegetation	Cereal crop
	Cropland/natural vegetation mosaic				
Seasonally or permanently inundated	Premature wetland				
Unvegetated	Urban and built-up land	Urban and built-up land	Urban	Urban	Urban
	Barren or sparsely vegetated	Barren or sparsely vegetated	Unvegetated	Unvegetated	Barren or sparsely vegetated
	Water	Water	Water	Water	Water
	Permanent snow and ice				Snow and ice

Land cover classifications for MLCT are: forest, woodlands, grasses/cereals, shrub lands, croplands and mosaics, seasonally or permanently inundated and unvegetated. The classification was developed using ensemble supervised classification algorithm, specifically based on decision tree algorithm. Based on the MLCT, further land covers were developed by International Geosphere-Biosphere Programme (IGBP) and the University of Maryland (Hansen et al., 2003) (Table 4.0). An example of MLCT by IGBP classification for Asian region is further showed in Figure 1.0.

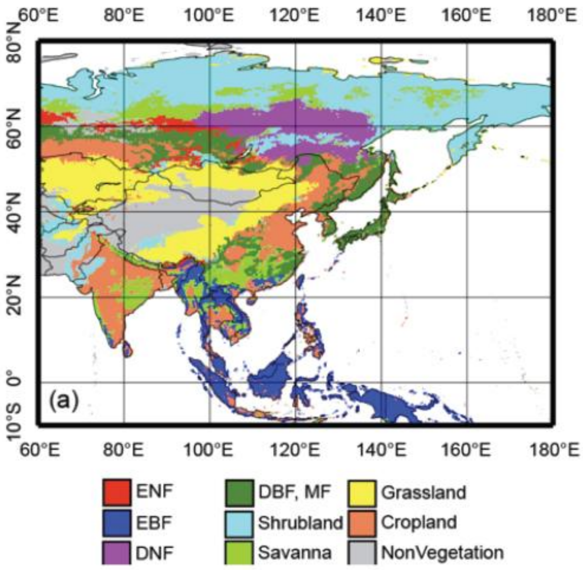


Figure 1. MLCT with IGBP classification: ENF (Evergreen needle leaf forest), EBF (Evergreen broadleaf forest), DNF (Deciduous needle leaf forest), DBF (Deciduous broadleaf forest) and MF (Mixed Forest) presented in the study. Source: Adapted from (Friedl et al., 2010).

The MCD12Q1 is one of the products used in the development of MODIS GPP/NPP model. The products have been continuously integrated in new NPP studies; for instance, a study by Alves et al. (2013) conducted for terrestrial NPP; Nunes et al. (2012) and Propastin et al. (2012) utilize the products for the tropical forests. We found MOD12Q1 is offering a good source of land cover data for scientific investigation.

Comparison of MODIS with Other Satellite

MODIS spectral, spatial and various functions have made MODIS a more advanced choice compared to other satellites such as NOAA AVHRR, Landsat TM and SPOT.

1. NOAA AVHRR

NOAA was launched in 1978. NOAA AVHRR is radiation-detector imager carrying the latest six channels (Table 5.0).

Table 5.0 NOAA AVHRR spectral properties included NOAA-6-12 and 14 (NOAA, 2013).

Channels	Resolution at Nadir(m)	Wavelengths (um)	Typical use
1		0.58-0.68	Daytime cloud an surface mapping
2		0.725-1.00	Land-water boundaries
3A		1.58-1.64	Snow and ice detection
3B	1.09	3.55-3.93	Night cloud mapping, sea surface temperature
4		10.30-11.30	Night cloud mapping, sea surface temperature
5		11.50-12.50	Sea surface temperature

2. Landsat TM

Other satellite image is products of Thematic Mapper scanner such as Landsat TM that was launched in 1982 carried on board Landsat 4 and 5. The satellite has 16-day repeat cycle and the image consists seven spectral bands (Table 6.0). However, the satellite was started decomposing in January 2013.

Table 6.0 Spectral properties of Landsat TM (USGS 2012).

Bands	Resolution at Nadir (m)	Wavelengths (um)
Band 1	30 m (Band 6, 120 m)	0.45-0.52
Band 2		0.52-0.60
Band 3		0.63-0.69
Band 4		0.76-0.90
Band 5		1.55-1.75
Band 6		10.40-12.50
Band 7		2.08-2.35

There are also many satellites under TM successor for instance Landsat 7 ETM+, however they are carrying higher spatial resolution of 15 m.

3. SPOT

New enhanced SPOT satellite is such as SPOT 5, 6 and 7 are so sophisticated with development of enhanced capability. However, all of them scanning the land surface at very higher resolution of between 2.5 to 1.5 m. The spectral properties of SPOT are showed in Table 7.0

Table 7.0 Spectral properties of SPOT (AIRBUS, 2018).

Bands	Resolution at Nadir (m)	Wavelengths (um)
Mono-spectral/ Panchromatic	(2.5, 5, 10)	0.61-0.68/0.48-0.71
Band 1	10–20	0.50-0.59
Band 2		0.61-0.68
Band 3		0.78-0.89
Band 4 SWIR: short-wave infrared, on SPOT 4 and SPOT 5		1.58-1.75

References

AIRBUS. (2018). Technical information about the SPOT satellite.

Alves, M. C., Carvalho, L. G., & Oliveira, M. S. (2013). Terrestrial Earth couple climate–carbon spatial variability and uncertainty. Global and Planetary Change, 111, 9–30. https://doi.org/10.1016/j.gloplacha.2013.08.009

Biudes, M. S., Souza, M. C., Machado, N. G., de Morais Danelichen, V. H., Vourlitis, G. L., & de Souza Nogueira, J. (2014). Modelling gross primary production of a tropical semi-deciduous forest in the southern Amazon Basin. International Journal of Remote Sensing, 35(4), 1540–1562. https://doi.org/10.1080/01431161.2013.878059

Caccamo, G., Chisholm, L. a., Bradstock, R. a., & Puotinen, M. L. (2011). Assessing the sensitivity of MODIS to monitor drought in high biomass
ecosystems. Remote Sensing of Environment, 115(10), 2626–2639. https://doi.org/10.1016/j.rse.2011.05.018

Fensholt, R., & Sandholt, I. (2003). Derivation of a shortwave infrared water stress index from MODIS near- and shortwave infrared data in a
semiarid environment. Remote Sensing of Environment, 87(1), 111–121. https://doi.org/10.1016/j.rse.2003.07.002

Friedl, M. a., Sulla-Menashe, D., Tan, B., Schneider, A., Ramankutty, N., Sibley, A., & Huang, X. (2010). MODIS Collection 5 global land cover: Algorithm refinements and characterization of new datasets. Remote Sensing of Environment, 114(1), 168–182. https://doi.org/10.1016/j.rse.2009.08.016

Hansen, M. C., DeFries, R. S., Townshend, J. R. G., Carroll, M., Dimiceli, C., & Sohlberg, R. a. (2003). Global Percent Tree Cover at a Spatial Resolution of 500 Meters: First Results of the MODIS Vegetation Continuous Fields Algorithm. Earth Interactions, 7(10), 1–15. https://doi.org/10.1175/1087-3562(2003)007<0001:GPTCAA>2.0.CO;2

NOAA. (2013). NOAA El Niño Page.

Nunes, E. L., Costa, M. H., Malhado, A. C. M., Dias, L. C. P., Vieira, S. a., Pinto, L. B., & Ladle, R. J. (2012). Monitoring carbon assimilation in South America's tropical forests: Model specification and application to the Amazonian droughts of 2005 and 2010. Remote Sensing of Environment, 117, 449–463. https://doi.org/10.1016/j.rse.2011.10.022

Propastin, P., Ibrom, a., Knohl, a., & Erasmi, S. (2012). Effects of canopy photosynthesis saturation on the estimation of gross primary productivity from MODIS data in a tropical forest. Remote Sensing of Environment, 121, 252–260. https://doi.org/10.1016/j.rse.2012.02.005

Qu, J. J., Gao, W., Kafatos, M., Murphy, R. E., & Salomonson, V. V. (2006). Earth Science Satellite Remote Sensing. https://doi.org/10.1007/978-3-540-37294-3

Sheldon, S., Xiao, X., & Biradar, C. (2012). Mapping evergreen forests in the Brazilian Amazon using MODIS and PALSAR 500-m mosaic imagery. ISPRS Journal of Photogrammetry and Remote Sensing, 74, 34–40. https://doi.org/10.1016/j.isprsjprs.2012.07.003

Xiong, X., Chiang, K., Sun, J., Barnes, W. L., Guenther, B., & Salomonson, V. V. (2009). NASA EOS Terra and Aqua MODIS on-orbit performance. Advances in Space Research, 43(3), 413–422. https://doi.org/10.1016/j.asr.2008.04.008

Xiong, X., Isaacman, A., & Barnes, W. (2006). MODIS Level-1B Products. In Earth Science Satellite Remote Sensing (pp. 33–49). Springer Berlin Heidelberg. https://doi.org/10.1007/978-3-540-37293-6_3

COMMUNITY ENGAGEMENT TOWARDS PRODUCTION OF AGARWOOD IN PENINSULAR MALAYSIA

Rozihawati, Z.[1], Ismail M.[2], Sheriza, M. R.[1], Zaiton, S.[1], Dahlan, T.[2] Norfaryanti, K[1]. and Mohd Hambali, M. J.[1]
[1]*Laboratory of Sustainable Bioresource Management, Institute of Tropical Forestry and Forest Product, Universiti Putra Malaysia*
[2]*Persatuan Pengusaha Gaharu Bumiputra Malaysia (PENGHARUM), Kuala Lumpur, Malaysia.*

Introduction

Persatuan Pengusaha Gaharu BumiputeraMalaysia (PENGHARUM) and Institute of Tropical Forestry and Forest Products (INTROP) have initiated joint collaboration to solve the problem of agarwood planting in Peninsular Malaysia. This collaboration is expected to enhance the knowledge and information transfer on the agarwood industries for farmers in facing the challenges effectively to produce a superior inoculum at an affordable price. The purpose of the collaboration between INTROP and PENGHARUM is to study the identification of Aquilaria species, its pest and disease, plantation, environment factors, inoculation, economy aspect, as well as quality and grading of agarwood product. Generally, the collaboration between INTROP and PENGHARUM is a perfect platform to educate and deliver the knowledge about agarwood to farmers through training, practical, and seminars (Figure 1).

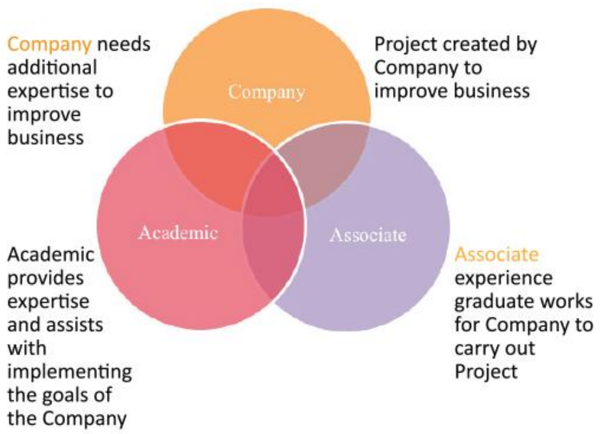


Figure 1. the collaboration elements of the project involving PENGHARUM (Company), INTROP (students and researchers), and Academicians (UPM lecturers).

Aquilaria species

Aquilaria spp. is agarwood tree and it belongs to the family Thymelaeaceae. There are generally 19 Aquilaria species worldwide, including eastern India, Southeast Asia such as Vietnam, Laos, Thailand, Malaysia, Brunei, Singapore, Indonesia and New Guinea. The species is *Aquilaria malaccensis, A. agallocha, A. crassna, A. subintegra, A. sinensis, A. microcarpa, A. beccariana, A. hirta, A. filarial, A. rostata, A. secundaria, A. apiculata, A. baillonii, A. banaense, A. grandiflora, A. khasiana, A. cumingiana, A. brachyantha* and *A. ovate* (Ismail and Mohd Zin, 2011). In Malaysia, there are five species of Aquilaria recorded namely *A. malaccensis, A. microcarpa, A. hirta, A. rostata* and *A. beccariana.* The establishment of Aquilaria species producing agarwood is gaining attention at national and local levels. This cause, the tree resources from the natural forest are depleting over the years. The agarwood is a fragrant wood that has been traded for a long time for its use in religious, medicinal and aromatic preparation (Ismail et al., 2016). According to Donovan and Puri (2004), the production of agarwood is uncertain and it is estimated that only about 10% of the Aquilaria trees in the forest may contain agarwood. In Malaysia, almost 100% of the agarwood are still collected from natural forest sources. The major states that allow the production of agarwood is Kelantan; which has issued 8 licenses of Aquilaria spp. and the wood of agarwood. Meanwhile, states such as Pahang, Kedah, and Johor also have been issued with permission from Forest Department (Ismail et al., 2017). The Aquilaria spp. has been listed as a threatened species by international organizations because it is highly susceptible to extinction (Mohd Farid et al., 2015). Due to the problems, the Aquilaria species especially *A. malaccensis* and *A. crassna* is the most tree species planted in the Peninsular Malaysia areas as described in Table 1.

Table 1. Distributions of Aquilaria species planting areas in Peninsular Malaysia.

Species	Country	Number of Tree	Area (ekar)	Number of member
Aquilaria Malaccensis and A. crassna	Johor	28,893	25.6	52
	Kedah	7,280	7	9
	Kelantan	23,500	24	5
	Melaka	22,600	21	12
	Negeri Sembilan	10,200	11	10
	Pahang	56,700	57	12
	Perak	25,500	27	17
	Sarawak	3,300	4	3
	Selangor	20,568	22	71
	Terengganu	5,400	5.5	3
	Lain-lain	101,059	102.9	31
Total		**305,000**	**307**	**225**

Sources: PENGHARUM, 2018.

Oleoresin production from Agarwood

Oleoresin is an ester or chrome derivative, hydrocarbon and sesquiterpenes or terpene (not polymer) that occurs in agar wood. It is also known as an essential oil, which is volatile when burned or heated to remove exotic fragrance scent (Ismail and Mohd Zin, 2011). The oleoresin in agarwood is highly commercial. The agarwood price of high quality oil can be as much as US$ 65,200 per liter in the year 2016 (MTIB, 2017). Ajmal Perfumes Company recorded US$ 3 trillion to US$ 3.6 trillion a year including pure agarwood oils, agarwood chips, perfumes and others downstream agarwood based on the product (Ismail et al., 2016). The agarwood is estimated that for the production of one litre of oil about 100 to 150 kg of agarwood (Gerard, 2007). However, Malaysian Timber Industry Board (MTIB) estimated the exchange rate of agarwood by industry for the production of agarwood oil is 100 kg of agarwood (MTIB, 2017).

In traditional industry, the oleoresin from agarwood tree used for perfume production. In the year 1970, the oleoresin agarwood in traditional industry has grown rapidly especially oleoresin production in Malaysia, due to high market demand mainly from the Middle East, North East Asia, and Europe (Ismail and Mohd Zin, 2011). Until now, the agarwood tree is considered as a valuable natural resource for producing various products especially perfumes to meet the needs of the well-being of the community and as a source of foreign exchange earnings (Ismail, 2017). It has also been used in traditional medicines to treat abdominal pain during pregnancy and after childbirth, fever, body as well as menstrual syndrome. In China and Asia countries, the agarwood also used in homeopathy medication (Burkill, 1996).

Collaborations between INTROP and PENGHARUM

PENGHARUM was established based on the cooperation between agarwood farmers and entrepreneurs to improve bumiputera economic status in agarwood industry. It was established on July 9, 2009 and currently has a total of 225 members (Table 2). The number of *Aquilaria spp.* registered under PENGHARUM is 305,000 trees equivalent to 307 acres, whereby the average of tree maturity is between 5-6 years old and the rest are over 10 years old. The distribution of *Aquilaria* species planting areas under PENGHARUM in Peninsular Malaysia is shown in Table 2.

Table 2. Number of PENGHARUM member in 2018.

Member of PENGHARUM	Number of member
Farmer	120
Retired Government Staff	43
Government Staff	28
Company	21
Others	13
Total	**225**

Sources: PENGHARUM, 2018

In 2010, PENGHARUM and Forestry Faculty of UPM have collaborated in organizing the National Seminar of Agarwood. The seminar was held to develop knowledge among the public on issues related to policy, natural resources, harvesting, processing, marketing, and promotion of agarwood in Malaysia. In addition, the Forestry Department of Peninsular Malaysia, Universiti Putra Malaysia (UPM), Malaysian Timber Industry Board (MTIB), and Forest Research Institute Malaysia (FRIM) have also worked on development of agarwood industry in Malaysia with PENGHARUM. However, the most successful inoculum product is very expensive and farmers are forced to spend a high cost for the inoculation process of each tree per hectare. This situation hinders the development of agarwood industry especially to farmers. Due to this problem, INTROP and PENGHARUM as the knowledge transfer provider under the collaboration of agarwood production are highly required for these farmers.

In 2017, PENGHARUM continues to share knowledge with INTROP as the extension of knowledge transfer program with agarwood farmers. The results of the collaboration between INTROP and PENGHARUM showed a significant result in screening the inoculum product with low cost (Figure 2). The studied inoculum product is being tested on *Aquilaria crasna* and *A. malaccensis* trees in several areas such as Jasin, Melaka and Semenyih, Selangor (Figures 3 and 4). The inoculum also will be induced in several agarwood plantation areas in Peninsular Malaysia.

Figure 2. One-month symptom of after inoculum induce

Figure 3. *Aquilaria crasna* in Jasin, Melaka.

Figure 4. *Aquilaria malaccensis* in Semenyih, Selangor

Conclusion

Generally, collaboration between INTROP and PENGHARUM is a perfect platform to educate and deliver the knowledge about agarwood to farmers through training, practical, and seminars. Especially, to study the identification of *Aquilaria* species, its pest and disease, plantation, environment factors, inoculation, economy aspect, as well as quality and grading of agarwood product. In addition, the *Aquilaria* species is considered as a valuable natural resource for producing various products especially perfumes to meet the needs of the well-being of the community and as a source of foreign exchange earnings.

References

Burkil, I. H. 1996. A Dictionary of the economic Products of the Malay Peninsular. Ministry of Agriculture, Kuala Lumpur.

Donovan, D.R. and Puri, P.K. 2004. "Learning from traditional knowledge of non-timber forest products: Penan Benalui and the Autecology of Aquilaria in Indonesian Borneo". Ecology and Society (9):3. [Online] URL:http://www.ecologyandsociety. org/vol9/iss3/art3.

Gerard A.P. 2007. "Agarwood: the life of a wounded tree.," https://iias.asia/sites/default/files /IIAS_NL45_2425.pdf. Assessed on 2007.

Ismail, M. and Mohd Zin, J. 2011. Gaharu Komoditi Khazanah. Kayu Gaharu(M) SDN.BHD.

Ismail, M. Aminah, M. and Dahlan, T. 2016. "Industri Gaharu di Malaysia; kearah Kelestarian Sumber Khazanah Warisan", Buletin PENGHARUM. 6 p.

Ismail M. 2017. Inokulasi Karas dan Penggredan Gaharu. Kertas Pembentangan Kursus Penilaian Pokok Karas dan Gaharu, Institut Penilaian Negara (INSPEN), Jabatan Penilaian dan Perkhidmatan Harta, Kementerian Kewangan Malaysia. Hotel Sri Malaysia, Marang, Terengganu. 27-30 Ogos 2017.

MTIB 2017. Mesyuarat Jawatankuasa Nasional Pembangunan Karas dan Gaharu Bil 1/2017. Menara PGRM Cheras, Kuala Lumpur. 27 Mac 2017.

ACTIVITIES

TRAINING • WORKSHOP • CONFERENCE

COMMUNITY OF PRACTICE PROGRAM (COP) 2017

Date : 3rd to 4th April 2017
Venue : Seminar Room, the Undercroft, Universiti Teknologi PETRONAS

Laboratory of Biocomposite Technology has sent 2 staff to University Teknologi Petronas (UTP) in conjunction to its LFSD Open Day. The main objective of the participation is to join the Community of Practices (COP) and the main objective of this COP formation is to establish a platform for networking and collaborating in MS ISO/IEC 17025:2005 and in any other field or opportunities. By gathering the communities, it is LFSD hope to promote UTP's capabilities leading towards strategic collaborations besides sharing knowledge, experience and latest technologies with universities, agencies and industry players. After the program, the committee hope of the formation of virtual community of practice, collaborative program through online i.e. communication via email, facebook and sharing and exchange information on latest technology, issue, daily machine problems etc.

PLANT CULTURE TISSUE COURSE

Date : 16th to 18th May 2017
Venue : Institute of Bioscience (IBS), UPM

The course is organized by Biodiversity Unit, Institute of Bioscience, UPM. The objective of the course is to provide participants with an introduction and disclosure of the basic things that need to be done in the conduct of plant tissue culture. There are three important bases when one wants to do plant tissue culture, namely the provision of media, sterilization methods and aseptic techniques of apparatus, tools, media, explant and methods of tissue culture either directly from explosives or subculture to multiplication purposes. The speakers are Mrs. Julia Abdul Aziz (Senior Science Officer) and a contract lecturer from Faculty of Agriculture UPM, Prof. Madya Dr. Maheran Abdul Aziz.

9TH CONFERENCE INTERNATIONAL GEOPOLYMER CAMP WITH SHORT COURSES

Date : 10th to 12th July 2017
Venue : Saint Quentin, France

The course is organized by Geopolymer Institute as Saint Quentin, Paris. There are two sessions in this Camp: 1st day start with short courses for the newcomers and the following days were conference sessions. During short courses, participants was exposed to the right technique in producing geopolymer binder or resin especially for cement, composite and coating applications. In addition, the geopolymer founder, Prof Dr Joseph Davidovits explain on the right terminology for geopolymer, chemistry behind formulation of geopolymer and its properties. He also highlights on the successful products which have use geopolymer process as to form binder, concrete, composite, anti-corrosive coating, architectural design and many more from various industries around the world. During conference sessions, various topics from geopolymer research and applications were highlight. Keynotes was given by Prof Waltraud Kriven from University of Illinois, USA on "The geopolymer route to high tech ceramics" and "Natural fiber reinforced geopolymer". In addition, many industries with geopolymer based products were in the conference session to share their latest finding and projects on geopolymer. The industry involved were from GeoMITS (show their latest mixers for making geopolymer), Renca (Geocement and its 3D printing machine for infrastructure), Monolith (invented by sculptors to create a monument by using ancient secrets and modern science of stone) and many more. Researchers from universities were also in the conference to share their current projects in geopolymer which are from Sejong University (Korea), Ostfold University College (Norway), Universidade do Minho (Portugal), Universiti Teknologi Petronas, Universiti Putra Malaysia and many more.

25TH ANNUAL INTERNATIONAL CONFERENCE ON COMPOSITES AND NANO ENGINEERING

Date : 16th to 22th July 2017
Venue : Rome, Italy

The conference was organized by Prof David Hui from University of Orleans (USA), with co-organizer from University of Salerno, Italy. Around 700 to 800 papers were presented during this conference from researcher around the world. The conference sessions were divided into different theme such as materials for sustainable energy; nanotechnology; sandwich and FGM structures; design and development; damage, durability and structural integrity; mechanical behaviour, and many more. Many interesting keynotes were presented such as from Professor Jagannathan Sankar (North Carolina A&T State University, NC) on "Revolutionizing metallic biomaterials", Professor Pantelis Botsaris (Democritus University of Thrace, Greece) on "Funding trends on research, Horizon 2020", Professor Abdalla M Darwish (Dillard University, USA) on "Inorganic nanocomposite films with polymer nanofillers made by concurrent multi-beam multi-target pulsed laser deposition", Professor Marek Godlewski (Institute of Physics, Polish Academy Science, Poland) on "High-K oxides from electronics to biomedical applications" and many more. In addition, discussion on future collaboration between Universiti Putra Malaysia and Universiti of Salerno, Italy was also done during the conference. Professor Luciano Feo and Dr Rossa from University of Salerno have agreed to discuss further on the possible collaboration in term of research between University of Salerno and UPM.

ARCGIS ESSENTIAL WORKFLOW AND BUILDING GEODATABASE

Date : 2nd – 4th and 9th – 11th August 2017
Venue : Esri Malaysia, Menara PJX-HM Shah Tower, Petaling Jaya

Essential workflow and building geodatabase is a training for handling various data types for various application such as mapping forest for high quality wood demarcation, wood disease area which also can be integrated with climatological data. In fact, land use area information can be exquisite by collecting area information in points, line and shape that can be further applied for specific application, for example, mapping land use type (plantation or forestry) area, assessing suitable drainage systems for efficient water irrigation, mapping plantation area before planting to maximize land usage and so on. There were many participants involves included researcher form Lembaga Koko Malaysia, universities and from private companies.

TRAINING WORKSHOP ON PULP AND PAPERMAKING TECHNOLOGIES ON NON-WOODY FIBER MATERIALS

Date : 21st August - 9th September 2017
Venue : Beijing, China

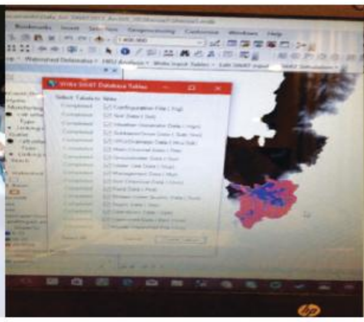
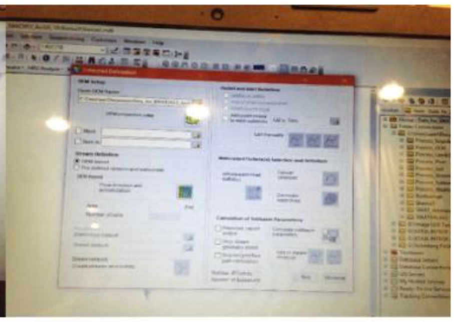
Three staffs from Laboratory of Biopolymer and Derivatives, INTROP represented Malaysia to the Training Workshop on Pulp and Papermaking Technologies on Non-Woody Fiber Materials on 21 August to 9 September 2017. This training workshop was organized by China National Pulp and Paper Research Institute (CNPPRI) and was sponsored by China Ministry of Science and Technology. The participation involved seven different countries listed as Malaysia, Bangladesh, Indonesia, Philippines, Egypt, North Korea and China which successful gathered 19 experts of Pulp and Paper Technology. It was a fruitful training workshop which encompassed theoretical lectures, laboratory practical, pilot plant visits and factories visits. The content of the training workshop started from the forest, pulping, bleaching, papermaking, waste treatment and management and latest technology in pulp and paper area either not only in research and development but also the practice in the industries of China.




5TH SOIL & WATER ASSESSMENT TOOLS CONFERENCE AND WORKSHOP IN SOUTH EAST AND EAST ASIA

Date : 27th to 28th October 2017
Venue : Hotel Bangi-Putrajaya, Bangi

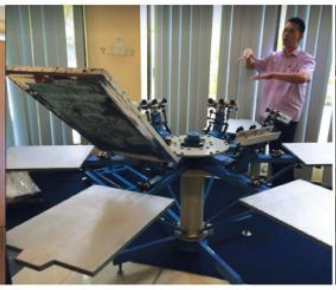
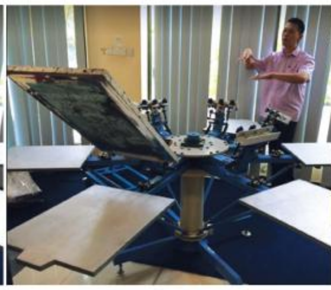
The Soil and Water Assessment Tool (SWAT) is a public domain model jointly developed by USDA Agricultural Research Service (USDA-ARS) and Texas AgriLife Research, part of The Texas A&M University System. Various application can be implemented by applying this tools for example for plantation area and forest assessing land use impact after logging activity. SWAT is widely used in assessing soil erosion prevention and control, non-point source pollution control and regional management in watersheds. In specific, SWAT is a river basin-scale model to simulate the quality and quantity of surface and ground water and predict the environmental impact of land management practices on different soil patterns and land use patterns.

THICK FILM FABRICATION WORKSHOP 2017

Date : 7th - 8th November 2017
Venue : Institute of Advanced Materials (ITMA), UPM

Thick Film Fabrication Workshop 2017 was organized by Institute of Advanced Materials (ITMA) on the 7-8 November 2017. The workshop was divided into three session namely theoretical lectures, laboratory hands-on and mill visit. The lectures comprised of 'Introduction to Thick Film Technology' and 'Screen Printing Process'. During laboratory hands-on, the participants were taught on how to self-prepare the thick film paste which then applied them during screen printing process and thick film final fabrication. The participants were brought by bus to visit Khai Lien Silk Screen Suppliers (M) Sdn. Bhd. which situated in Bandar Baru Bangi, Selangor. The mill is applying the technology of thick film fabrication and also supplying screen printer, pad printer and other related machineries dedicated for silk screen printing materials and equipment. The content of this workshop is very useful towards the research for making specialty paper such as security paper or information storage paper.


WORKSHOP ON NANOENABLED PRODUCTS AND MEDICAL DEVICES: TESTING AND REGULATION OF NANOSAFETY

Date : 13th – 14th November 2017
Venue : SIRIM Berhad, Kulim Hi-Tech Park, Kedah

The workshop was organized by Industrial Centre of Innovation in Biomedical, SIRIM Industrial Research, SIRIM Berhad with the aim to provide knowledge on toxicological background of nanomaterial and the current recommended practices for safe and healthy work in nanomaterial laboratories and producing industry. The course includes a series of lectures that addressed exposure routes and the toxicological principles of nanomaterials as well as hands-on training of experimental approaches for in vitro cell-nanomaterial interactions. Among the topics discussed were Basic Introduction to Biological and Environmental Aspects of Nanoparticles/Nanomaterials, Health and Environmental Impact of Nanomaterials, Basic Introduction to Toxicology on the Micro- and Nano-Scale and Risk Assessment and Regulations. The invited speaker was Prof Harald F. Krug, the Manager for the International Research Cooperations in the General Management of Empa – Swiss Laboratories for Materials Science & Technology in Switzerland (St. Gallen). His company NanoCASE GmbH focuses on education and consulting of manufacturing companies on the safe production and use of nanomaterials or nanomaterial-containing products. He is also a Professor at the University of Berne since August 2008. His work is focused on applications and implications of new materials, especially nanomaterials.

WORKSHOP ON RESPONSE SURFACE METHODOLOGY

Date : 15th - 16th November 2017
Venue : InfoComm Development Centre, UPM

Response Surface Methodology (RSM) is a statistical methodology of constructing approximations of the system behavior using results of the response analyses calculated at a series of points in the variable space. This method is applied in various fields such as chemistry, physics, engineering as well as biotechnology to find the optimum response. The objective of these 2 days' workshop is to provide both theoretical and practical aspects, especially for process optimization. The speakers of this workshop were Assoc. Prof. Dr. Rosfarizan Mohamad from INTROP, Dr. Tan Joo Shun from Universiti Sains Malaysia and Dr. Nagasundara Ramanan Ramakrishnan from Arkema Thiochemicals Sdn. Bhd. This workshop has attracted 41 participants from various government agencies such as UPM, UiTM, IIUM and Malaysian Rubber Board, and also from private universities such UTP, Unisel and UTAR.

MECHANICAL CHARACTERIZATIONS OF BIOFIBER AND BIOCOMPOSITE MATERIALS WORKSHOP

Date :15th - 16th November 2017
Venue : Seminar Room, INTROP, UPM

The Laboratory of Biocomposite Technology (BIOCOMPOSITE) has organized a workshop on mechanical characterizations of biofiber and biocomposite materials. This workshop was officiated by YBrs. Dr. Norkhairunnisa Mazlan, Head of Programme of Biocomposite Technology and Design, INTROP. The main objective of this workshop was to impart a platform for sharing the knowledge regarding the machines used for wood and natural fiber researches. This workshop was also providing trainings for participants to operate the universal testing machine and dynamic mechanical analyzer, as well as analyzing related data. There was a total of 21 participants have attended this workshop, most of them consisted of researchers and postgraduate students of INTROP. The speakers of the workshop were Prof. Ir. Dr. Mohd Sapuan Salit, Dr. Norkhairunnisa Mazlan from UPM, and Dr. Ridhwan Jumaidin from UTeM. In addition, the demonstrators of the workshop were Mr. Josh Lai Say Aik from TA Instruments Malaysia and Mr. Hanafi Abdullah from Instron Malaysia.



SEMINAR ON NANOCELLULOSE 2017

Date : 27th November 2017
Venue : OSH Hall, Universiti Putra Malaysia

The seminar was organized by Laboratory of Biopolymer and Derivatives, Institute of Tropical Forestry and Forest Products (INTROP). The aim of the seminar was to provide a platform for researchers working on nanocellulose to gain new knowledge related to their research, as well as to discuss the progress of nanocellulose research and development in Malaysia. The speakers were Prof. Derek Gray from McGill University, Canada; Dr Rezal Khairi Ahmad from NanoMalaysia Berhad and Mr Kamarulzaman Kamaruddin from National Nanotechnology Centre, MOSTI. Prof. Gray is one of the pioneer in nanocellulose research. During the seminar, he shared his experience in nanocellulose development as well as potential applications of the nanocellulose.


TRAINING ON CORRESPONDENCE ANALYSIS, DATA MINING AND EXPLORATORY MULTIVARIATE STATISTICS STRATEGIES

Date : 27th – 28th November 2017
Venue : Garcinia and Morinda Room, Auditorium FRIM, Forest Research Institute of Malaysia, Kepong, Selangor

The Factominer software is a package in the R software for various analyzes such as multivariate analysis. Furthermore, this R software is suitable for data mining in various fields of study and research. This is especially in the field of natural resource related research to study and control environmental factors that affect quality of fiber production. Therefore, participants from the course can find out the patent of the data being studied including: the type of relationship between the variables, the axis that has a great impact in the analysis, classification of groups that may result from the data being used, while it may alter the type of final decision and the way of final results presentation. The course was conducted by Dr. Marc Roda INTROP Research Fellow. This training course is one of the MoU activities between UPM and FRIM since 1986.

NANOTECH MIDDLE EAST 2017 INTERNATIONAL CONFERENCE AND EXHIBITION

Date : 4th - 6th December 2017
Venue : Dubai, UAE

The Nanotech Middle East Conference and Exhibition (Previously known as Nanotech Dubai) is organized by Setcor Conferences and Exhibitions, Dubai jointly with Surtech Middle East 2017 and Biotech Middle East 2017. Its remains the main and most dedicated and commercially-focused Nanotechnology and Nanoscience conference and exhibition in the Middle East, Gulf Region, North Africa, Africa and South Asia region offering scientists, technology developers, business leaders, including senior executives of leading nanotech companies, business development teams from large and mid-size companies, investors and other industry experts, a unique opportunity to identify new technology trends, development tools, product opportunities, R&D collaborations, and commercialization partners. I attended this conference during Dec 4-6, 2017 and presented my research finding on Dynamic Mechanical properties of Oil palm nano filler/Kenaf hybrid composites. Conferences attracted high profile plenary and keynote lectures from Middle East and Europe. Besides that, several good researches work on nanotechnology and its application in different field shared by researchers from around the world in special sessions, oral and poster sessions. Few companies from Middle East, Pakistan, India, Europe display equipment, accessory and solution developed for different application through Nanotechnology.

NETWORKING AND LINKAGES

VISIT TO BINTANG HIJAU FOREST RESERVE, PERAK

Date : 27th – 28th July 2017
Venue : Bintang Hijau Forest Reserve, Perak

Bintang Hijau Forest Reserve is comprised of 3 forest areas, namely Hulu Perak, Kuala Kangsar and Larut/Matang. This study focused only on the Bintang Hijau Forest Reserve (Larut Matang). Lately, water catchment is often associated with water security and emphasis is given to the value assessment for water catchment services. Among the major sources of forest is the supply of clean water. Forest is a catchment area. With the water catchment area, it is capable of providing clean water as well as other functions such as flood control agents, irrigation and agricultural irrigation for aquaculture. In general, this study was conducted to determine the economic value and to establish the payment of ecosystem services (PES) of the water catchment forest in Permanent Forest Reserve. Therefore, the research team was visited the forest reserve for collecting ground information from villagers and also from District Forest Officer.

RESEARCH COLLABORATION REPORT BETWEEN INTROP, UPM & SNU, SOUTH KOREA

Date : 2nd September – 30th October 2017
Venue : Seoul National University (SNU), South Korea

Research Collaboration between INTROP, UPM and Seoul National University (SNU), South Korea was held for 2 months. SNU is a South Korean University that has many fields of science and technology. I have been placed in Collage of Agriculture and Life Sciences (CALS) in Lignin Laboratory and Biocomposite. Within two months, I was able to complete a study related to the research of lignin modification coupled with biopolymer and kenaf wood fibers to produce insulating composites. The above research work is divided into three stages. The first stage was the provision of lignin modification from sulphite lignin with maleic anhydride. The method is to use microwave oven. Second stage of composite material preparation. Modification of lignin is mixed with biopolymer by using exterder twin screw machine to produce compound between lignin, biopolymer and kenaf fiber. The compound is in the form of pellets. Third stage testing of composite materials. The pellets were inserted into injection molding in certain temperatures and channeled into dog-shaped molds. The sample was tested for durability such as tensile and flexural. Data is recorded and analyzed. My two-month experience found that SNU's working culture was very diligent and cooperative with each other. Laboratory equipment is sufficient to do research work. Every Monday is a presentation of student research work with lecturers in the laboratory. We can share research information made by the student until they graduate.

TECHNICAL VISIT FROM SCG PACKAGING PUBLIC COMPANY LIMITED (SCGP), THAILAND

Date : 26th –28th September 2017
Venue : Institute of Tropical Forestry and Forest Products (INTROP), UPM

Two representatives from SCG Packaging Public Company Limited (SCGP), Thailand visit Institute of Tropical Forestry and Forest Products (INTROP), Universiti Putra Malaysia on 26th until 28th Sept 2017. The main objective of the visit was to observe the extraction activity, synthesis of tannin resin, lab visit and discuss on the progress of the project on the Eucalyptus tree bark for value added product adhesive for wood based panels. Three days visit in UPM give an opportunity to the representatives of SCGP to observe the whole process of tannin extraction until the synthesis of tannin resin. They also have an opportunity to observe current technology in UPM. Apart of that, more collaboration and networking with Thailand industry can be made in the future on the utilization of waste material such as Eucalyptus barks.

PUBLIC LECTURE ON FRANCE-MALAYSIA POTENTIAL INITIAVES IN RESEARCH AND EDUCATION OF FOREST WOOD BIOECONOMY

Date : 30th October 2017
Venue : Briefing Hall, Administration Building, UPM

The public lecture was co-organized by the Laboratory of Bioresource Management and Laboratory of Biocomposite Technology, INTROP in cooperation with the French Agriculture Research Institute, (CIRAD). The lecture was focuses on sharing the potential opportunities in research and education of forest wood and bioeconomy. There was a session that specifically discussed the potential initiatives that could be collaborated. Postgraduates' degree/double-degree, researcher attachment, joint supervision of postgraduate students, are among the potential future collaboration activities. The speaker is the Director at Agroparistech in France. Agroparistech is the leading French university in engineering, agronomy and forestry. Besides being the Director, she is also the top French scientist in wood mechanics and wood industry.

VISIT TO SABAH SOFTWOODS BERHAD

Date : 9th – 10th October 2017
Venue : Tawau, Sabah

A research group from INTROP and the Faculty of Forestry, UPM had visited Sabah Softwoods Berhad (SSB) to discuss research collaboration between UPM and SSB and the Borneo Forest Consortium (BFC). During the meeting, INTROP also intends to hold a Memorandum of Understanding (MoU) with University of Sunshine Coast, Brisbane which involves activities such as research collaboration on Eucalyptus plantation, exchange of student and staff as well as short-term training for graduate students. We were also visited to the Eucalyptus tree planting area, seed trial, research nursery, showcase area for breeding of Eucalyptus species and tissue culture laboratory for production of Eucalyptus and Acacia mangium seedlings.

VISIT TO INNOVATIVE COMPOSITE CENTER (ICC), KANAZAWA INSTITUTE OF TECHNOLOGY, JAPAN

Date : 19th – 21st December 2017
Venue : Kanazawa Institute of Technology, Japan

Innovative Composite Centre (ICC) is a research centre under Kanazawa Institute of Technology (KIT), Japan. ICC KIT is one of the Japan's leading research centres in biocomposites, which involved in numerous national and industrial projects. Among the collaborations are with Toyota, Mitsubishi, Kuka, Chuetsu Pulp, and etc. Assoc. Prof. Dr Hidayah Ariffin received an invitation from ICC KIT to visit their facilities and discuss the potential collaboration between UPM and KIT. It was a fruitful visit as several potential collaborations have been agreed. A MoU between both institutions will be signed soon. This networking activity is expected to increase the potential of INTROP staff to have more international research collaborations, especially with Japan.

NEW MEMBERS

Name: Assoc. Prof. Ir. Ts. Dr. Mohamed Thariq bin Haji Hameed Sultan

Email: thariq@upm.edu.my

Field of specialization: Structural Health Monitoring (SHM), Composite Materials and Impact Studies

Recent Projects

Project's name : Design and fabrication of Crash Box and Food Tray Table from Bamboo/Roselle Hybrid Composites
Source of fund : Grant Putra IPB
Amount : RM152,300.00

What is your feeling when joining INTROP?
I am excited and motivated to join INTROP as my expertise can be clearly seen here at INTROP.

What is your opinion of INTROP's working environment?
Happy working environment.

How do you see INTROP 5 years onwards?
We are now given the status of HICoE. Hope that we can be equivalent to the international standards in near future.

Name: Dr. Sairizal bin Misri

Email: sairizal@upm.edu.my

Field of specialization: Composite Material, Concurrent Engineering

Recent Projects

Project's name : Selection of Material & Fabrication of Safety Helmet
Source of fund : Sime Darby
Amount : RM 65,000

What is your feeling when joining INTROP?
Once I've been with INTROP, a lot of potential can be produced. In INTROP, there are various types of natural resources for research. It makes it easier for me to know every kind of nature resource more deeply in term of strength and cellulous.

What is your strategy for the future as Post-Doctoral in INTROP?
I will help in finding the funds. Introducing INTROP to the industry in order to facilitate the relationship in research.

What is your opinion of INTROP's working environment?
The working environment is intimately friendly and interoperable among staff. This simplifies and refines existing tasks.

How do you see INTROP 5 years onwards?
INTROP will be the main source of UPM in producing natural resource-based products as well as a source of information resources in all types of natural materials.

STUDENTS GRADUATED IN 2017

DOCTOR OF PHILOSOPHY

Name : Harmaen Ahmad Saffian
Matric No. : GS30023
Field of Study : Biocomposite Technology
Thesis Title : *Development of Slow Release Fertilizer from Oil Palm Empty Fruit Bunch Biopolymer Composites*
Supervisor : Assoc. Prof. Dr. Khalina Abdan

Name : Naheed Saba
Matric No. : GS38067
Field of Study : Biocomposite Technology
Thesis Title : *Development and Characterization of Flame Retardant Oil Palm Filler/Kenaf Reinforced Hybrid*
Supervisor : Prof. Dr. Paridah Md. Tahir

Name : Amin Moradbak
Matric No. : GS35347
Field of Study : Pulp and Paper Technology
Thesis Title : *Production of High Quality Packaging Paper from Bamboo Asam Pulp with Addition of Cellulose Nanocrystals*
Supervisor : Prof. Dr. Paridah Md. Tahir

Name : Mazlina Bt Mahdzar
Matric No. : GS34712
Field of Study : Nature Tourism
Thesis Title : *Effects of Memorable Tourism Experiences as Mediators on Visits to Mulu National Park, Sarawak, Malaysia*
Supervisor : Prof. Dr. Ahmad Bin Shuib

Name : Chia Kei Wei
Matric No. : GS31944
Field of Study : Nature Tourism
Thesis Title : *Economic Impact of Rural Coastal Tourism in Semporna, Sabah, Malaysia*
Supervisor : Prof. Dr. Ahmad Bin Shuib

Name : Emiliana Rose Binti Jusoh @ Taib
Matric No. : GS34548
Field of Study : Biopolymer and Derivatives
Thesis Title : *Blend of Jatropha Oil/Palm Oil-Based Acrylated Epoxidized Prepolymer For Ultraviolet Curable Coating*
Supervisor : Prof. Dr. Luqman Chuah Abdullah

Name : Seyed Eshagh Ebadi
Matric No. : GS35286
Field of Study : Biocomposite Technology
Thesis Title : *Multivariate Optimization of Hydrothermal Treatment of Oil Palm Wood in Buffered Media*
Supervisor : Prof. Dr. Zaidon Ashaari

STUDENTS GRADUATED IN 2017

Name : Mohd Asim Khan
Matric No. : GS39945
Field of Study : Biocomposite Technology
Thesis Title : *Development and Characterization of Kenaf/Pineapple Leaf Fibre-Reinforced Phenolic Hybrid Composites*
Supervisor : Dr. Mohammad Jawaid

MASTER

Name : Nor Atirah Bt Mohd Aridi
Matric No. : GS41986
Field of Study : Biocomposite Technology and Design
Thesis Title : *Mechanical and Morphological Properties of Rice Husk-Filled Polypropylene Composites with Struktol Compatibiliser*
Supervisor : Prof. Ir. Dr. Mohd Sapuan Salit

Name : Nur Marliana Binti Mohamad
Matric No. : GS42780
Field of Study : Biocomposite Technology and Design
Thesis Title : *Effect of Immersion Treatment of Fibre on Mechanical Properties of Pultruded Kenaf Vinyl Ester Composites*
Supervisor : Prof. Ir. Dr. Mohd Sapuan Salit

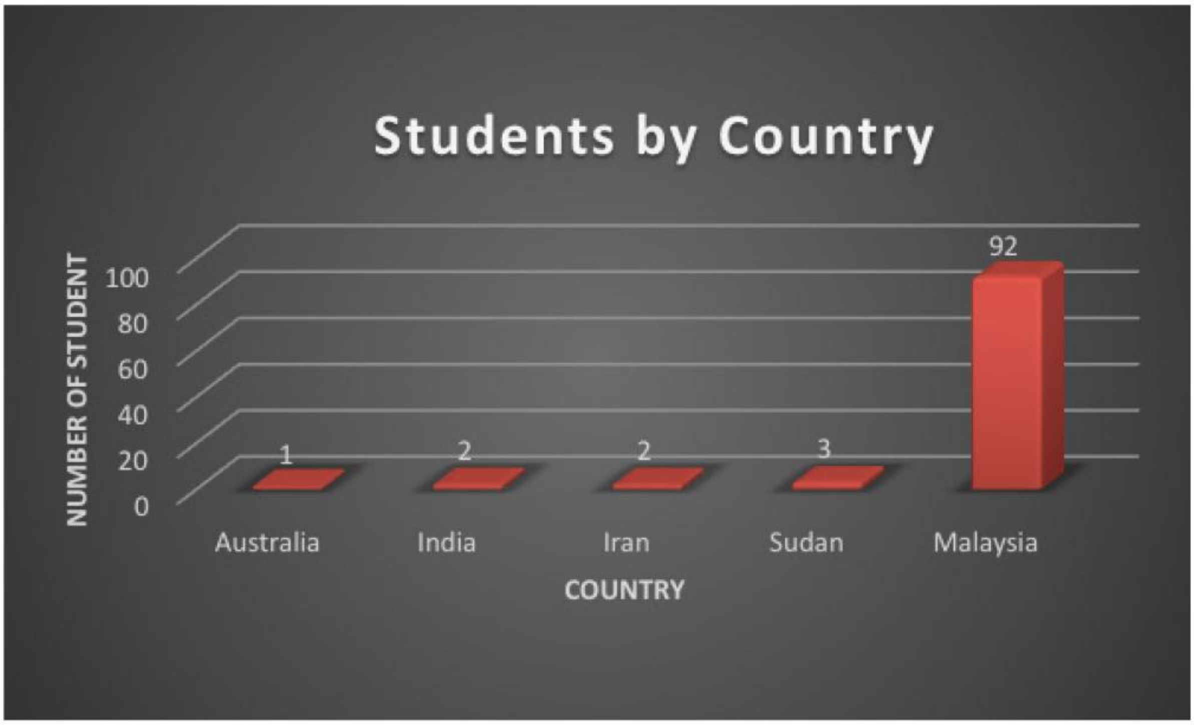
Name : Muhammad Mirza Bin Ariffin
Matric No. : GS42128
Field of Study : Biopolymer, Pulp and Paper Technology
Thesis Title : *Preparation and Characterization of Jatropha Oil-Based Polyrethane Acrylate with Graphene Oxide/Zinc Oxide for Anti-Corrosive Coatings*
Supervisor : Dr. Min Min Aung @ Aishah Abdullah

Name : Shahirah Binti Manap
Matric No. : GS36898
Field of Study : Biopolymer and Derivatives
Thesis Title : *Production and Optimization of Carboxmethyl Cellulase and Filter Paperase of Locally Isolated Streptomyces Lucitanus C5/2 Under Submerged Fermentation of Napier Grass*
Supervisor : Prof. Dr. Rosfarizan Mohamad

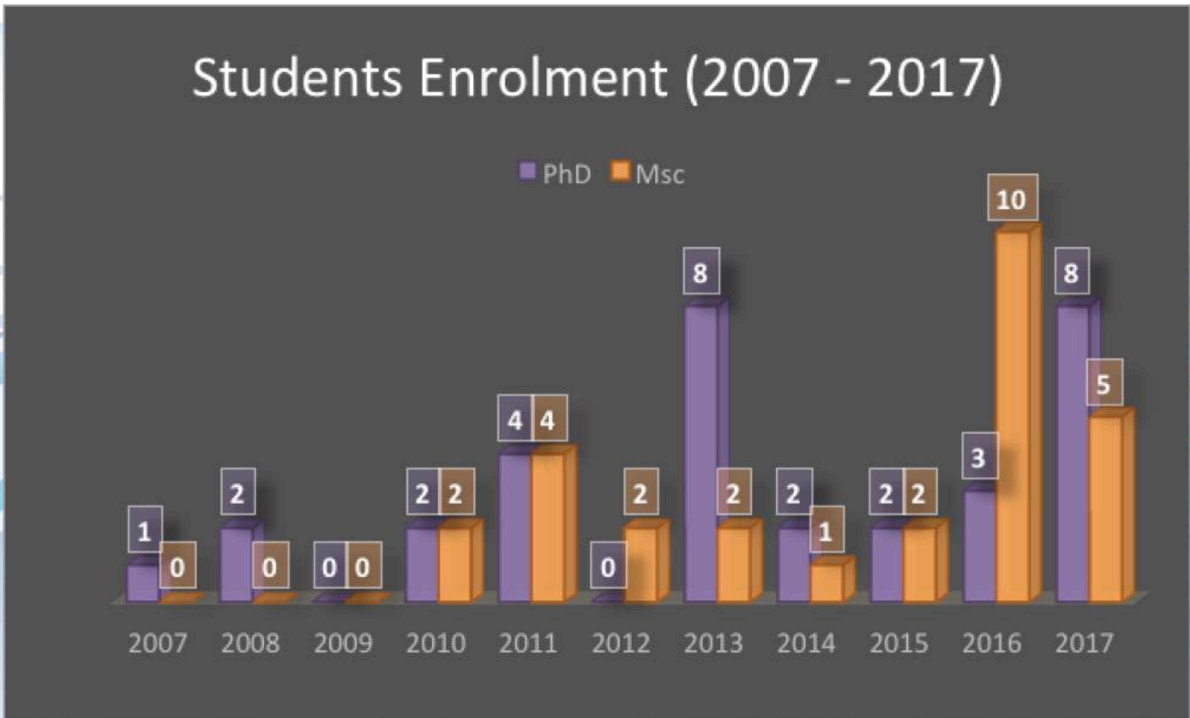
Name : Nurhanisah Binti Mohd Hawari
Matric No. : GS39002
Field of Study : Biocomposite Product Design
Thesis Title : *Design and Fabrication of Eco-Friendly Prosthetic Leg Socket Made from Woven Kenaf-Glass Fiber Hybrid Composite*
Supervisor : Dr. Mohammad Jawaid

POSTGRADUATE STUDIES STATISTICS

INTROP's Postgraduate Students by Country (Active)



INTROP's Postgraduate Students - Trends in Enrolment



INTROP'S ACHIEVEMENTS FOR 2017

PUBLICATIONS

- CIJ: 96
- Q1 & Q2: 58
- Books: 10
- Chapter in Book: 23

POSTGRADUATE STUDENTS

PhD
5

Master
4

Total Students (active) in 2017
29

INNOVATIONS

4 Patented File

LINKAGES & COLLABORATIONS

10 MoU/MoA

NEW RESEARCH GRANTS

Private Grant
RM597,196

International Grant
RM2,545,300

Public Grant
RM1,358,671.56

TOTAL
RM4,501,167.56

Institute of Tropical Forestry and Forest Products (INTROP)
Universiti Putra Malaysia (UPM)
43400 UPM Serdang, Selangor, Malaysia.
Phone : +603 8947 1880 / 1881 / 1895
Fax : +603 8947 1896
www.introp.upm.edu.my