



**UKM-YSD CHAIR  
FOR SUSTAINABLE DEVELOPMENT**

FINAL REPORT  
ZERO WASTE TECHNOLOGY PROGRAM  
2010-2020

**Forging Mutually Beneficial Partnership**

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## 1.0 INTRODUCTION

In Sept 2007, the Ministry of Higher Education recognised the value of having senior management in the university (ie Deputy VC for Industry and Community Partnerships) to focus on and drive engagement with industry, NGOs, govt agencies and communities to establish mutually beneficial partnerships. All of these aim to enhance and enrich the core business of the university – education, research and service.

Through this portfolio, one of the valuable platforms that drives research via public-private partnership is that of an endowed chair. UKM's relationship with Yayasan Sime Darby began through the creation of an endowed chair which contributes to a powerful university-industry partnership as it provides for funding which catalyses and leapfrogs the development of a critical area of knowledge.

This began in early 2010, when UKM convinced Yayasan Sime Darby of its strengths and the value of establishing a UKM-YSD endowed chair for the science of climate change. We were eventually successful and the chair was launched in the early part of 2010.

Just after this, on the 11<sup>th</sup> February 2010, UKM together with 7 other public universities received an invitation from YSD to submit a proposal for the establishment of an endowed chair for sustainable development. These were part of its activities to promote the conservation of the environment and the protection of ecosystems. YSD decided to cooperate with a top Malaysian university by providing financial support for the research and other relevant activities in the area of sustainable development. Several universities presented their proposals, and based on a set of evaluations, UKM was chosen with its aim to lead and direct research relevant to the palm oil industry to make Malaysia a model for sustainable development for the world.



Figure 1.1 Mission of UKM-YSD Chair for sustainable development

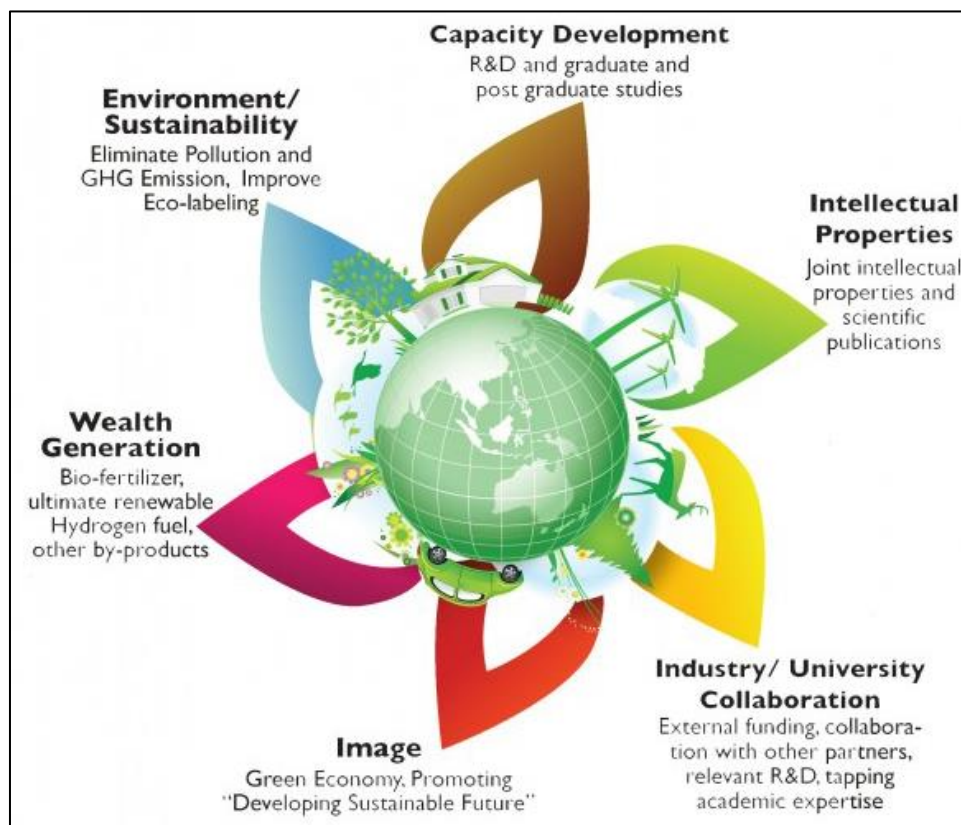


Figure 1.2 Impacts and benefits of UKM-YSD Chair for sustainable development

## 2.0 CHAIRHOLDER AND CO-CHAIRHOLDER

The Mission of the Chair is to turn palm oil mills into green, carbon-neutral factories with zero discharge, simultaneously increasing revenues and ensuring long-term productivity and sustainability of the industry.

As Chairholder and Co-Chairholder, the responsibilities during the tenure include:

- Spearheading and coordinating R&D specifically in biohydrogen and assisting in the integration of the process chain towards zero waste in the palm oil mill
- Assisting with the soliciting of funds for R&D related to the Chair's objectives
- Identifying appropriate collaborators/researchers to expand R&D collaboration
- Assisting the publication of articles in high impact journals while stimulating the protection of intellectual property generated from R&D activities
- Delivering invited lectures and presenting papers in seminars on subjects related to the her area of expertise
- Promoting the Chair internationally

Table 1.1 List of chairholders and co-chairholder




Designation	1 <sup>st</sup> Chairholder	2 <sup>nd</sup> Chairholder	Co-Chairholder
Picture			
Appointment	2012 – 2015	2016- 2021	2017-2021
Expertise	Bioenergy, Hydrogen Production, Biotechnology, Fermentation	Biohydrogen, Green Synergy, Circular Economy	Fluid Mechanics, Process Safety, Sustainable Process Technology, Carbon Capture
Affiliation	Wageningen University Research, Netherlands	Feng Chia University, Taiwan	Universiti Kebangsaan Malaysia



Figure 1.3 Research group members

### 3.0 FINANCIAL REPORT

The activities were funded by research grants sourced by UKM internally and externally (government research grants) as well as the dividend from the invested endowment money. In addition, the research work is also supported by Sime Darby Plantation Research Sdn. Bhd. research project (UKM & SDR Research projects). The breakdown of the research funding is presented in Table 1.1:

Table 3.1: Cumulative Funding from Various Sources

No	Source of fund	Amount (RM)	(%)
1	UKM (internal and external sources)	12,349,187.24	47
2	Dividend from UKM-YSD endowment	7,453,115.46	28
3	Sime Darby Research Sdn Bhd	5,434,000.00	20
4	YSD Scholarships Program	1,334,400.00	5
	<b>Total</b>	<b>26,570,702.70</b>	<b>100</b>

Beside payment for the Chair holder's fees and honorarium, the dividend from UKM-YSD endowment that is invested at Amanah Raya Berhad was used for the emolument of contract researchers and administrative staffs, purchase of research consumables, knowledge transfers activities and other services for the management of the Chair. List of funding is presented in Table 1.2.

Table 3.2: List of funding received by UKM-YSD chair

No	Grant/Funding	TA#1	TA#2A	TA#2B	TA#3A	TA#3B	TA#4	TA#5	TA#6	Total
<b>UKM YSD Chair [ A ]</b>										
1.	Dividend from endowment									<b>7,453,115.46</b>
<b>Sime Darby Research Sdn Bhd [ B ]</b>										
1.	Grant	900,000.00	554,000.00	-	1,368,000.00	842,000.00	719,000.00	527,000.00	524,000.00	<b>5,434,000.00</b>
<b>UKM (Internal) [ C1 ]</b>										
1.	UKM Arus Perdana						600,000.00		450,000.00*	1,050,000.00
2.	UKM Industri			5,000.00	35,000.00		19,000.00	36,200.00	50,000.00	145,200.00
3.	UKM OUP				35,000.00					35,000.00
4.	UKM Zamalah				19,200.00	27,600.00				46,800.00
5.	UKM BPKP					4,997.00				4,997.00
6.	UKM GRA					7,200.00				7,200.00
7.	UKM Dana Impak Perdana					434,600.00	200,000.00		380,000.00	1,014,600.00
8.	UKM Modal Insan				60,000.00			60,000.00	60,000.00	180,000.00
9.	UKM PIK ETP						220,000.00			220,000.00
10.	UKM DPP							50,000.00		50,000.00
11.	DIP-2017-007 (Prof. Sobri)							150,000.00		150,000.00
12.	GUP-2018-092 (Prof. Sobri)							60,000.00		60,000.00
13.	GGPM-2016-030 (Dr. Haan)								45,000.00	45,000.00
14.	GGPM-2017-041 (Dr. Peer)				50,000.00					50,000.00
15.	GUP-2016-007 (Dr. Shuhaida)						149,800.00			149,800.00
16.	DIP-2017-020 (Dr. Shahbudin)	150,000.00								150,000.00
17.	GUP-2018-042 (Dr. Shahbudin)	80,000.00								80,000.00
18.	03-01-02-SF0696 (Prof. Zahira)					186,400.00				186,400.00
19.	DPP-2013-112 (Prof Zahira)					50,000.00				50,000.00
20.	GUP-2013-063 (Prof Zahira)					60,000.00				60,000.00
21.	DPP-2014-057 (Prof Sobri)							25,000.00		25,000.00
22.	DPP-2015-050 (Prof Sobri)							5,000.00		5,000.00
23.	ZF-2014-013 (Prof Sobri)							25,000.00		25,000.00
24.	GUP-2018-105 (Dr. Peer)				60,000.00					60,000.00
25.	DIP-2019-008 (Dr. Peer)				100,000.00					100,000.00
26.	DPP-2014-024 (Prof Wahab)								30,000.00	30,000.00
27.	GGPM-2017-060 (Dr Nazlina)							50,000.00		50,000.00
28.	DIP-2014-030 (Prof Jamaliah)				200,000.00					200,000.00
29.	DIP-2018-024 (Prof Jamaliah)				100,000.00					100,000.00

30	DPP-2013-104 (Prof Jamaliah)				50,000.00					50,000.00
31	DPP-2014-145 (Prof Jamaliah)				30,000.00					30,000.00
32	DPP-2015-133 (Prof Jamaliah)				9,000.00					9,000.00
33	GUP-2016-040 (Prof Jamaliah)				150,000.00					150,000.00
34	DIP-2012-01 (Prof Wahab)								393,000.00	393,000.00
35	ETP-2013-019 (Prof Osman/Dr Shuhaida)							222,000.00		222,000.00
36	GUP-2019-016 (Dr Shuhaida)							70,000.00		70,000.00
37	GGPM-2015-007 (Dr Shuhaida)							30,000.00		30,000.00
38	INDUSTRI-2011-017 (Dr Shuhaida)							34,800.00		34,800.00
39	DIP-2016-031 (Prof Wahab)								150,000.00	150,000.00
										<b>5,818,797.00</b>
<b>UKM (External) [ C2 ]</b>										
1.	USM Graduated Scheme				100,800.00					100,800.00
2.	Knowledge Transfer Program (KTP), KPT	107,000.00							133,000.00	240,000.00
3.	MyBrain, KPT				21,600.00				10,000.00	31,600.00
4.	LRGS, KTP				1,722,000.00				1,398,000.00	3,120,000.00
5.	FRGS							86,000.00		86,000.00
6.	PRGS							202,000.00		202,000.00
7.	National Biotech Initiative Project, MOSTI				100,000.00					100,000.00
8.	Gangsu Institute of Light Industry							74,000.00		74,000.00
10.	FRGS/1/2018/TK02/UKM/01/1							90,000.00		90,000.00
11.	FRGS/1/2016/TK02/UKM/02/4								114,000.00	114,000.00
12.	FRGS/1/2017/TK02/UKM/01/1				86,700.00					86,700.00
13.	FRGSTOPDOWN/2013/TK06/UKM/01/1						180,000.00			180,000.00
14.	MRUN-RAKAN RU-2019-004/1 (Prof Sobri)							203,700.00		203,700.00
15.	KK-2019-014 (Prof Sobri)							100,000.00		100,000.00
16.	LRGS/TD/2011/UMP/PG/04 (Prof Sobri)							660,999.00		660,999.00
17.	FRGS/1/2019/TK10/UKM/02/2 (Dr. Peer)				107,200.00					107,200.00
18.	LRGS MRUN/F2/01/2019/4/2 (Dr. Peer)				39,000.00					39,000.00
19.	SMP2020 (Dana Antarabangsa bersama WUR)				175,000.00					175,000.00
20.	FRGS/1/2011/TK/UKM/02/40 (Prof Jamaliah)				76,000.00					76,000.00
21.	FRGS/1/2015/TK02/UKM/01/1 (Prof Wahab)								90,000.00	90,000.00
22.	KK-2017-006 (Prof Wahab/ Dr Ang)								648,391.24	648,391.24
										<b>6,530,390.24</b>
<b>Total UKM [ C ] { C1 + C2 }</b>										<b>12,349,187.24</b>
<b>Grand Total [ A+B+C ]</b>										<b>25,236,302.70</b>



#### 4.0 LIST OF KNOWLEDGE DISSEMINATION ACTIVITIES

Table 4.2 List of knowledge dissemination activities by UKM-YSD chair

NO.	PROFESSOR & INDUSTRY	ORGANIZATION	CATEGORY	TITLE	DATE
1.	Prof. Dr. Bruce Dale	Michigan State University	Seminar	Energy, The Wealth Of Nations And Human Developments: Why We Must Have Sustainable Biofuels	21 <sup>st</sup> Jun 2012
2.	Prof. Phang Siew Moi	University Malaya, Malaysia	Workshop	Algal Biology – Isolation, Identification and Screening	27 <sup>th</sup> August 2013
3.	Prof. Dr. Ille C. Gebeshuber	Vienna University of Technology	Workshop	Algal Nano Technology	27 <sup>th</sup> August 2013
4.	Prof. Faizal Bux	Durban University and Technology, South Africa	Workshop	Algal Technology Applications – Waste Water Treatment, CO2 Fixation, Feed and Food, Energy, Biofertilizer and Fine Chemicals.	27 <sup>th</sup> August 2013
5.	Prof. Dr. Yusuf Chisti	University of Massey, New Zealand	Workshop	Algal Cultivation – Algal Bioreactor Design, Mass Cultivation	27 <sup>th</sup> August 2013
6.	Prof. Ir. Dr. Mohd Sobri Takriff	Universiti Kebangsaan Malaysia	Workshop	Commercial Opportunities and Challenges	28 <sup>th</sup> August 2013
7.	Dr. Maria Barbosa	Wageningen University, Netherlands	Workshop	Harvesting and Downstream Processing	28 <sup>th</sup> August 2013
8.	Dr. Pieter Claassen	Wageningen University, Netherlands	Public Talk	Opportunities for Hydrogen Bacteria in a Biobased Economy	27 <sup>th</sup> February 2014

9.	Ir. Bambang Trisakti	Universitas Sumatera Utara, Indonesia	Seminar	Seminar on Biogas Pilot Plant	26 <sup>th</sup> November 2014
10.	Dato' Dr. Mohd Nazlee Kamal	Malaysian Biotechnology Corporation (BiotechCorp), Malaysia	Conference	Transition to Biohydrogen Economy	16 <sup>th</sup> December 2014
11.	Mr. Yuji Nagata	Toshiba Fuel Cell Power System Corporation, Japan	Conference	The Continues Challenge For Full Scale Commercialization Toshiba Fuel Cell "ENE-FARM"	16 <sup>th</sup> December 2014
12.	Prof. Dr. Jun Miyake	Osaka University, Japan	Conference	The use of artificial intelligence in the production of bioenergy	16 <sup>th</sup> December 2014
13.	Prof. Chiu-Yue Lin	Feng Chia University, Taiwan	Conference	Pilot-Scale Fermentative Hydrogen/ Methane Production System	16 <sup>th</sup> December 2014
14.	Assoc. Prof. Dr. Ian O'hara	Queensland University Technology, Australia	Conference	Biorefineries – Creating Economic Opportunities from Biofuels and Bio-Product	16 <sup>th</sup> December 2014
15.	Prof. Dr. Alan Guwy	University of South Wales, United Kingdom	Conference	Biohydrogen, A Gateway Process for Recovery of Energy and Resources from Biomass	17 <sup>th</sup> December 2014
16.	Dr. Haznan Abimanyu	Indonesia Institute of Science, Indonesia	Conference	Production of Fuel Grade Bioethanol from Lignocellulosic Biomass in a Pilot Plant and Utilization of Co-Products	17 <sup>th</sup> December 2014

17.	Dr. Hj Mohd Tusirin Hj Mohd Nor	C-Heart Corporation Sdn. Bhd. Malaysia	Conference	Recovery, Upgrading, Storage and Application of Biohydrogen; Palm Oil Industry Perspective	17 <sup>th</sup> December 2014
18.	Prof. Dr. Hyung Keun Song	Korea Institute of Science and Technology, Korea	Conference	A Bioethanol Perspective as Transportation Fuel and its Production from the Lignocellulose Biomass	17 <sup>th</sup> December 2014
19.	Prof. Dr. Patrick Hallenbeck	University of Montreal, Canada	Conference	Fundamental of microbial based hydrogen production	17 <sup>th</sup> December 2014
20.	Prof. Dr. Qiang Long	ChongQing University, China	Conference	Cultivation of algae from waste water	17 <sup>th</sup> December 2014
21.	Prof. Shu-Yii Wu	Feng Chia University, Taiwan	Public Talk	Research Methodology and Writing of Thesis	31 <sup>st</sup> July 2015
22.	Prof. Shu-Yii Wu	Feng Chia University, Taiwan	Public Talk	Symbiotic Eco-community and the Bioeconomy	4 <sup>th</sup> August 2015
23.	Prof Yujie Feng	Harbin Institute of Technology, China	Public Talk	Microbial Electrolysis Cell in Bioenergy Generation	19 <sup>th</sup> July 2016
24.	Prof. Dato' Dr. Ali Hassan	Universiti Putra Malaysia, Malaysia	Workshop	POME to Energy : Opportunities and Challenges	5 <sup>th</sup> April 2016
25.	Prof. Shu-Yii Wu	Feng Chia University, Taiwan	Workshop	Enhanced Energy Recovery from Waste Water through sequential BioH <sub>2</sub> & CH <sub>2</sub> Fermentation	5 <sup>th</sup> April 2016
26.	Dr. Muhammad Kismurtono	Lembaga Ilmu Pengetahuan Indonesia	Workshop	Renewable energy from Palm Oil mill effluent: Indonesia perspective	5 <sup>th</sup> April 2016

27.	Prof. Dr. Poonsuk Prasertsan	Prince Songkla University Thailand	Workshop	Potential of palm oil biomass as a source of renewable resources	5 <sup>th</sup> April 2016
28.	Dr. Somphon O-Thong	Thaksin University Thailand	Workshop	Enhanced biohydrogen production from palm oil mill waste	5 <sup>th</sup> April 2016
29.	Prof. Shu-Yii Wu	Feng Chia University, Taiwan	Public Talk	Industry 4.0 IR & Taiwan's Experience	19 <sup>th</sup> July 2017
30.	Prof. Shu-Yii Wu	Feng Chia University, Taiwan	International Seminar	Biological Cycle of Circular Economy for Biomass Resources	2 <sup>nd</sup> October 2018
31.	Prof. Dato' Ir. Dr. Abdul Wahab Mohammad	Universiti Kebangsaan Malaysia	International Seminar	Future Biorefineries: Unlocking the potential of Fine Chemical and Value Added Byproducts	2 <sup>nd</sup> October 2018
32.	Prof. Alissara Reungsang	Khon Kaen Universty, Thailand	International Seminar	Thailand's Energy 4.0 and the Utilization of Agricultural and Biomass for Bioenergy / Biofuels Production in Thailand	2 <sup>nd</sup> October 2018
33.	Prof. Dr. Sarani Zakaria	Universiti Kebangsaan Malaysia	International Seminar	Biological Polyurethane from Liquefaction of Lignocellulosic and Cellulosic Biomass	2 <sup>nd</sup> October 2018
34.	Dato' Leong Kin Mun	Malaysia Biomass Industries Confederation, Malaysia	International Seminar	Malaysian Biomass Industry: Opportunities and Challenges	2 <sup>nd</sup> October 2018
35.	Dr. Ir. Hens Saputra	Agency for the Assessment and Application of	International Seminar	Innovation od Slow Release Fertilizer	2 <sup>nd</sup> October 2018

		Technology (BPPT), Indonesia			
36.	Prof. Dr. Puan Yatim	Universiti Kebangsaan Malaysia	International Seminar	Role of Oil Palm Biomass and Biorefining in Promoting Circular Economy	2 <sup>nd</sup> October 2018
37.	Mohd. Zulkarnaini Wahab	Waris Nove Sdn. Bhd. Malaysia	International Seminar	Developing EFB Cellulose Industry that Potentially Contributes to Sustainable Society	2 <sup>nd</sup> October 2018
38.	Dr. Vijaya Subramaniam	Malaysian Palm Oil Board	International Seminar	Role of LCA in Malaysian Biomass Industry	2 <sup>nd</sup> October 2018
39.	Dr. Wan Asma Wan Ibrahim	Forest Research Institute Malaysia (FRIM)	International Seminar	Potential Value Added Products from Forestry Biomass: R&D in FRIM	2 <sup>nd</sup> October 2018
40.	Dr. Shuhaida Harun	Universiti Kebangsaan Malaysia	Workshop	Introduction to Biomass Compositional Analysis: Theory and Background	3 <sup>rd</sup> October 2018
41.	Dr. Shuhaida Harun	Universiti Kebangsaan Malaysia	Workshop	Theories, Standards and Methods in Biomass Compositional Analysis	3 <sup>rd</sup> October 2018
42.	Prof. Shu-Yii Wu	Feng Chia University, Taiwan	Public Lecture	The Education of Engineering from R&D to Industry Implementation and Marketing	3 <sup>rd</sup> October 2018
43.	Tuan Hj Shawaluddin Tahiruddin	Industry Specialist	Public Lecture	The Role of Engineers in Sustainable Development, Engineering and Sustainability: Attitudes & Actions	19 <sup>th</sup> November 2018
44.	Prof. Shu-Yii Wu	Feng Chia University, Taiwan	Public Lecture	Recent and Future Trends in Chemical Engineering	1 <sup>st</sup> March 2019

45.	Dr. Azzam A.M. Abu Habib	Islamic University of Gaza, Palestin	Public Talk	Water Crisis in Palestine: Challenges and Solution	17 <sup>th</sup> April 2019
46.	Prof. Shu-Yii Wu	Feng Chia University, Taiwan	CYAL 2019	Fourth Industrial Technology for Renewable Energy	26 <sup>th</sup> September 2019
47.	Prof. Ir. Dr. Mohd. Sobri Takriff	Universiti Kebangsaan Malaysia	CYAL 2019	Renewable Resources and Energy	23 <sup>th</sup> September 2019
48.	Prof. Dr. Tusirin Mohd.Nor En. Mohammed Faisal Prof. Dato; Dr. Kamaruzzaman Sopian Ir. Khor Bee Chin	Sime Darby Plantation Research Sdn. Bhd. Solar Energy Research Institute Indah Water Konsortium	CYAL 2019	Water, Food and Energy Resources in ASEAN beyond 2020	24 <sup>th</sup> September 2019
49.	Ir. Noraziah Muda	TNB Research	CYAL 2019	The Role of Renewable Energy in Mitigating Climate Change	24 <sup>th</sup> September 2019
50.	Assoc. Prof. Dr. Puan Yatim	Universiti Kebangsaan Malaysia	CYAL 2019	Social and Socio-Economic Impacts along the Value Chain of the ASEAN Biomass Resources and Renewable Energy	24 <sup>th</sup> September 2019
51.	Mr. Edisham Mohd Sukor	Sustainable Energy Development Authority, Malaysia	CYAL 2019	Sustainable energy scenario in Malaysia	24 <sup>th</sup> September 2019

52.	Dr. Peer Mohamed	Universiti Kebangsaan Malaysia	CYAL 2019	Sustainable Indigenous Resources for Renewable Energy Production	24 <sup>th</sup> September 2019
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## 5.0 LIST OF RESEARCH PUBLICATIONS

Table 5.1 List of Publication Thrust Area 1

No.	Soft copy	Year	Author	Title	Journal / Proceeding
1.	T1-1	2019	Nurul Noramelya Zulkefli, Mohd Shahbudin Masdar, Wan Nor Roslam Wan Isahak, Jamaliah Md Jahim, Syahril Anuar Md Rejab, Chew Chien Lye.	Removal of hydrogen sulfide from a biogas mimic by using impregnated activated carbon adsorbent. <i>PLoS ONE</i> 14(2): 1-25.	Index Journal (Q1 IF 2.776)
2.	T1-2	2019.	Nur Yusra Mt Yusuf, Mohd Shahbudin Masdar, Wan Nor Roslam Wan Isahak, Darman Nordin, Teuku Husaini, Edy Herianto Majlan, Shu-Yii Wu, Syahril Anuar Md Rejab, Chew Chien Lye	Impregnated carbon–ionic liquid as innovative adsorbent for H <sub>2</sub> /CO <sub>2</sub> separation from biohydrogen. <i>International Journal of Hydrogen Energy</i> 44 (6): 3414-3424.	Index Journal (Q2 IF 4.084)
3.	T1-3	2019.	Mohd Zaidi Sidek, Yu-N Cheah, Nurul Noramelya Zulkefli, Nur Yusra Mt Yusuf, Wan Nor Roslam Wan Isahak, Ramli Sitanggang, Mohd Shahbudin Masdar	Effect of Impregnated Activated Carbon on Carbon Dioxide Adsorption Performance for Biohydrogen Purification. <i>Materials Research Express</i> 6(1): 015510.	Index Journal (Q3 IF 1.449)
4.	T1-4	2018	Muhammad Zhaahir Sidek, Mohd Shahbudin Masdar, Nik Muhammad Hafiz Nik Dir, Nur Fatimah Ainaa Amran, Simreth Kaur	Integrasi Sistem Penulenan Biohidrogen dan Aplikasi Sel Fuel (Integration of Biohydrogen Purification System and Fuel Cell Application). <i>Jurnal Kejuruteraan</i> 1(2) 2018: 41-48.	Index Journal



			Dhalywal A/P Ajit Sing, Wong Woon Loong.		
5.	T1-5	2018	Siti Najibah Abd Rahman, Mohd Shahbudin Masdar, Masli Irwan Rosli Edy Herianto Majlan, Syahril Anuar Md Rejab, Chew Chien Lye. 2018	Simulation of PEMFC Stack for Portable Power Generator Application (Simulasi Tindakan PEMFC bagi Aplikasi Penjana Kuasa Mudah Alih). <i>Jurnal Kejuruteraan SI</i> 1(1): 1-10.	Index Journal
6.	T1-6	2018.	Ravin Navi, Siti Aishah Anuar, Nur Yusra Mt Yusuf, Wan Nor Roslam Wan Isahak, Mohd Shahbudin Masdar	Amine-mixed oxide hybrid materials for carbon dioxide adsorption from CO/H mixture. <i>Materials Research Express</i> 5(5): 055501.	Index Journal (Q3 IF 1.449)
7.	T1-7	2018	Fung Yun Ru, Nurul Noramelya Zulkefli, Nur Yusra Mt Yusuf, Mohd Shahbudin Masdar. 2018.	Effect of Operating Parameter on H <sub>2</sub> /CO <sub>2</sub> Gas Separation using Electrochemical Cell. <i>International Journal of Applied Engineering Research</i> 13 (1): 505-510.	Index Journal Scopus
8.	T1-8	2017	Shu-Yi Wu, I-Chih Hsia, Chun-Min Liu, Nur Yusra Mt Yusuf, Wan Nor Roslam Wan Isahak, Mohd Shahbudin Masdar.	A novel bio-cellulose membrane and modified adsorption approach in CO <sub>2</sub> /H <sub>2</sub> separation technique for PEM fuel cell applications. <i>International Journal of Hydrogen Energy</i> 42 (45): 27630-27640.	Index Journal (Q2 IF 4.084)
9.	T1-9	2017	Nurul Noramelya Zulkefli, Mohd Shahbudin Masdar, Wan Nor	Mathematical modelling and simulation on the adsorption of Hydrogen Sulfide (H <sub>2</sub> S) gas. <i>IOP Conf.</i>	Index Proceeding

			Roslam Wan Isahak, Jamaliah Md Jahim, Edy Herianto Majlan, Syahril Anuar Md Rejab, Chew Chien Lye	<i>Series: Materials Science and Engineering 206 (2017) 012069: 1-14.</i>	Conference Proceeding
10.	T1-10	2017	Nur Yusra Mt Yusuf, Mohd Shahbudin Masdar, Wan Nor Roslam Wan Isahak, Darman Nordin, Teuku Husaini, Edy Herianto Majlan, Syahril Anuar Md Rejab, Chen Li Chew	Ionic liquid-impregnated activated carbon for biohydrogen purification in an adsorption unit. <i>IOP Conf. Series: Materials Science and Engineering 206 (2017) 012071: 1-13.</i>	Conference Proceeding
11.	T1-11	2017	Izzati Nadia Mohamad, Rosiah Rohani, Mohd Tusirin Mohd Nor, Pieternel Claassen, Muhammad Syukri Abd. Rahaman, Mohd. Shahbudin Mastar@Masdar, And Masli Irwan Rosli.	An Overview of Gas-Upgrading Technologies for Biohydrogen Produced from Treatment of Palm Oil Mill Effluent. <i>Journal of Engineering Science and Technology</i> 12 (3): 725 – 755.	Index Journal Scopus
12.	T1-12	2017	Nur Izzati A. Ghani, Nur Yusra Mt Yusuf, Wan Nor Roslam Wan Isahak, Mohd Shahbuddin Masdar..	Modification of Activated Carbon from Biomass Nypa and Amine Functional Groups as Carbon Dioxide Adsorbent. <i>Journal of Physical Science</i> 28(Supp. 1): 227–240.	Index Journal Scopus
13.	T1-13	2016	Nur Yusra Mt Yusuf, Wan Nor Roslam Wan Isahak, Darman Nordin, Teuku Husaini	Challenges and Prospects of Bio-hydrogen Production for PEMFC Application: A Review. <i>International Journal of Applied Engineering Research</i> 11 (19): 9960-9969.	Index Journal Scopus

14.	T1-14	2016	Nurul Noramelya Zulkefli, Mohd Shahbudin Masdar, Jamaliah Md Jahim, Edy Herianto Majlan. 2016.	Overview of H <sub>2</sub> S Removal Technologies from Biogas Production. <i>International Journal of Applied Engineering Research</i> . 11(20): 10060-10066.	Index Journal Scopus
15.	T1-15	2016	Siti Najibah Abd Rahman, Mohd Shahbudin Masdar, Masli Irwan Rosli, Edy Herianto Majlan, Teuku Husaini, Siti Kartom Kamarudin, Wan Ramli Wan Daud	Overview biohydrogen technologies and application in fuel cell technology. <i>Renewable and Sustainable Energy Reviews</i> 66: 137–162.	Index Journal (Q1 IF 10.556)
16.		2016	Siti Najibah Abd Rahman, Mohd Shahbudin Masdar, Masli Irwan Rosli, Edy Herianto Majlan, Teuku Husaini, Wan Ramli Wan Daud, Syahril Anuar Md Rejab, Chew Chien Lye.	Portable PEM fuel cell system: water and heat management. <i>Journal of Engineering Science and Technology</i> : 122 – 136.	Index Journal Scopus
17.	T1-17	2016	Izzati Nadia Mohamad, Rosiah Rohani, Mohd. Shahbudin Mastar@Masdar, Mohd Tusirin Mohd Nor, Jamaliah Md. Jahim.	Permeation properties of polymeric membranes for biohydrogen purification. <i>International Journal of Hydrogen Energy</i> 41:4474 -4488	Index Journal (Q1 IF 4.084)

Table 5.2 List of Publication Thrust Area 2

No.	Soft Copy	year	Author	Title	Journal / Proceeding
1.	T2-1	2018	Mohd Rashdan Ghazali, Shahridzal Azri Shahrum, Sahilah Abd. Mutalib, Aishah Elias, Aishah Ahmad. 2018.	Application of empty fruit bunches (EFB) and cow manure (CM) compost on the growth and yield of chili ( <i>Capsicum annum</i> ) treated with different fertilizers. <i>International Journal of ChemTech Research</i> 11 (10): 135-141.	Non-Index Journal
2.	T2-2	2018	Aishah Elias, Sahilah Abd. Mutalib, Wan Aida Wan Mustapha, Safiyyah Shahimi, Norhidayu Mohamed, Rul Aisyah Mat Repin. 2018.	Antioxidant content of Tomatoes ( <i>Lycopersicon esculentum</i> cv MT1) treated by different type of Pesticide, Fertilizer and growth medium in Compost. <i>International Journal of ChemTech Research</i> 11 (5): 387-393.	Non-Index Journal
3.	NA	2017	Shahridzal Azree Shahrum, Sahilah Abd. Mutalib, Mohd. Rashdan Ghazali, Rozida Mohd. Khalid, Aishah Elias, Kamal Wok and Aishah Ahmad.	Efficacy of turning and white technology in large composting process of empty fruit bunches (EFB) and palm oil mill effluent (POME). <i>6<sup>th</sup> International Conference on Fuel Cell &amp; Hydrogen Technology 2017</i> .	Conference Proceeding
4.	NA	2017	Aishah Elias, Sahilah Abdul Mutalib, Wan Aida Wan Mustapha,	Comparison of Total Phenolic Content and Antioxidant Activity of Tomato ( <i>Lycopersicon esculentum</i> Mill. cv	Conference Proceeding

			Norhidayu Mohamed, Kong Hui Sam, Safiyyah Shahimi, Rul Aisyah Mat Repin, Kamal Wok, and Aishah Ahmad. 2017.	MT1) planted in Medium Containing Different Pesticide, Compost and Fertilizer. <i>International Food Research Conference 2017. 25th-27th of July 2017. Vice chancellor complexes (Research and Innovation), University Putra Malaysia.</i>	
5.	NA	2017	Sahilah Abdul Mutalib	The significant of cellulolytic microorganisms in the decomposition of palm oil wastes and rice straw for sustainable agriculture health. <i>International Conference on Biology and Environmental Sciences. 19-20 th September 2017.</i>	Conference Proceeding
6.	T2-6	2016	Mohd Rashdan Ghazali, Sahilah Abd. Mutalib, Aminah Abdullah	Effect of cow manure and empty fruit bunches application treated with different fertilizers on growth and yield of chili ( <i>Capsicum annum</i> ). <i>AIP Conference Proceeding.s</i>	Conference Proceeding
7.	T2-7	2016	Aishah Elias, Sahilah Abd. Mutalib, Wan Aida Wan Mustapha	Effect of empty fruit bunch to the accumulated plant height, mass of fresh and dry weight of tomato plant treated with organic and inorganic fertilizer. <i>AIP Conference Proceedings.</i>	Conference Proceeding
8.	NA	2015	Mohd. Rashdan Ghazali, Shahridzal Azree Shahrum, Sahilah Abd. Mutalib, Rozida Mohd. Khalid, Kamal Wok and Aishah Ahmad.	Decomposition of empty fruit bunches and palm oil wastes into organic fertilizer on a larger scale. <i>International Congress of Malaysian Society for Microbiology 2015 (ICMSM2015).</i>	Conference Proceeding

Table 5.3 List of Publication Thrust Area 3A

No	Soft Copy	Year	Author	Title	Journal / proceeding
1.	T3A-1	2020	Nurul SakinahEngliman, Jamaliah Md Jahim, Peer Mohamed Abdul, Tang Pei Ling, Jian Ping Tan, Chin Boon Ong	Effectiveness of fouling mechanism for bacterial immobilization in polyvinylidene fluoride membranes for biohydrogen fermentation. <i>Food and Bioproducts Processing</i>	Index Journal (Q2 IF 3.324)
2.	T3A-2	2020	Mohamad FarizzuanAbdullah, Jamaliah Md Jahim, Peer Mohamed Abdul, Safa SenanMahmod	Effect of carbon/nitrogen ratio and ferric ion on the production of biohydrogen from palm oil mill effluent (POME). <i>Biocatalysis and Agricultural Biotechnology</i>	Index Journal (Q2 IF 2.26)
3.	T3A-3	2019	Nurul Adela Bukhari, Soh Kheang Loh, Abu Bakar Nasrin, Abdullah Amru Indera Luthfi, Shuhaida Harun, Peer Mohamed Abdul, Jamaliah Md Jahim	Compatibility of utilising nitrogen-rich oil palm trunk sap for succinic acid fermentation by <i>Actinobacillus succinogenes</i> 130Z. <i>Bioresource technology</i>	Index Journal (Q1 IF 6.669)
4.	T3A-4	2019	Muhammad Alif Fitri Hanipa, Peer Mohamed Abdul, Jamaliah Md. Jahim, Mohd Sobri Takriff, Alissara Reungsang, Shu-Yii Wu	Biotechnological approach to generate green biohydrogen through the utilization of succinate-rich fermentation wastewater. <i>International Journal of Hydrogen Energy</i>	Index Journal (Q2 IF 4.084)
5.	T3A-5	2019	Mohd Hafis Irsyad Mohd Faudzi, Jamaliah Md Jahim, Peer Mohamed Abdul, Chen-Yeon Chu, Shu-Yii Wu, Mohd Sobri Takriff, Shuhaida Harun	Kinetic Model of Thermophilic Biohydrogen Production from POME. <i>International Journal of Integrated Engineering</i>	Index Journal (Q2 IF 1.02)

6.	T3A-6	2019	Muhammad Alif Fitri Hanipa, Peer Mohamed Abdul, Jamaliah Md Jahim, Mohd Sobri Takriff, Alissara Reungsang	Valorising fermentation effluent rich in short-chain fatty acids and sugars for biohydrogen via photofermentation by <i>Rhodobacter sphaeroides</i> KKU-PS1 <i>IOP Conference Series: Earth and Environmental Science</i>	Conference Proceeding
7.	T3A-7	2019	Muhammad Arif Fikri Hamzah, Jamaliah Md Jahim, Peer Mohamed Abdul	Comparative start-up between mesophilic and thermophilic for acidified palm oil mill effluent treatment. <i>IOP Conference Series: Earth and Environmental Science</i>	Conference Proceeding
8.	T3A-8	2019	Chyi-How Lay, Tan-Phat Vo, Po-Yen Lin, Peer Mohamed Abdul, Chun-Min Liu, Chiu Yue Lin	Anaerobic hydrogen and methane production from low-strength beverage wastewater. <i>International Journal of Hydrogen Energy</i>	Index Journal (Q2 IF 4.084)
9.	T3A-9	2019	Safa Senan Mahmod, Azratul Madidah Azahar, Jian Ping Tan, Jamaliah Md. Jahim, Peer Mohamed Abdul, Mohd Shahbudin Masdar, Nurina Anuar, Mohammed Faisal Mohammed Yunus, Ahmad Jaril Asis, Shu-Yii Wu	Operation performance of up-flow anaerobic sludge blanket (UASB) bioreactor for biohydrogen production by self-granulated sludge using pre-treated palm oil mill effluent (POME) as carbon source. <i>Renewable energy</i>	Index Journal (Q1 IF 5.439)
10.	T3A-10	2019	Shalini Narayanan Arisht, Peer Mohamed Abdul, Chun Liu, Sheng Lin, Rizal Muzhafar Maaroff, Shu-Yii Wu, Jamaliah Md Jahim	Biotoxicity assessment and lignocellulosic structural changes of phosphoric acid pre-treated young coconut husk hydrolysate for biohydrogen production. <i>International Journal of Hydrogen Energy</i>	Index Journal (Q2 IF 4.084)
11.	T3A-11	2019	Muhammad Arif Fikri Hamzah, Jamaliah Md Jahim, Peer Mohamed Abdul, Ahmad Jaril Asis	Investigation of Temperature Effect on Start-Up Operation from Anaerobic Digestion of Acidified Palm Oil Mill Effluent <i>Energies</i>	Index Journal (Q2 IF 2.787)
12.	T3A-12	2019	Muhammad Azri Abd Nasir, Jamaliah Md Jahim, Peer Mohamed Abdul, Hemavathi Silvamany, Rizal Muzhafar	The use of acidified palm oil mill effluent for thermophilic biomethane production by changing the hydraulic retention time in anaerobic sequencing batch reactor.	Index Journal (Q2 IF 4.084) (Q1)

			Maaroff, Mohammed Faisal Mohammed Yunus	<i>International Journal of Hydrogen Energy</i>	
13.	T3A-13	2019	Rizal Muzhafar Maaroff, Jamaliah Md Jahim, Azratul Madihah Azahar, Peer Mohamed Abdul, Mohd Shahbudin Masdar, Darman Nordin, Muhammad Azri Abd Nasir	Biohydrogen production from palm oil mill effluent (POME) by two stage anaerobic sequencing batch reactor (ASBR) system for better utilization of carbon sources in POME.  <i>International Journal of Hydrogen energy.</i>	Index Journal (Q2 IF 4.084)
14.	T3A-14	2017	Nur Syakina Jamali, Jamaliah Md Jahim, Wan Nor Roslam Wan Isahak, Peer Mohamed Abdul	Particle size variations of activated carbon on biofilm formation in thermophilic biohydrogen production from palm oil mill effluent. <i>Energy conversion and management</i>	Index Journal (Q1 IF 7.181)
15.	T3A-15	2017	Safa Senan Mahmod, Jamaliah Md Jahim, Peer Mohamed Abdul	Pretreatment conditions of palm oil mill effluent (POME) for thermophilic biohydrogen production by mixed culture. <i>International Journal of Hydrogen Energy</i>	Index Journal (Q2 IF 4.084)
16.	T3A-16	2017	Nurul Sakinah Engliman, Peer Mohamed Abdul, Shu-Yii Wu, Jamaliah Md Jahim	Influence of iron (II) oxide nanoparticle on biohydrogen production in thermophilic mixed fermentation. <i>International Journal of Hydrogen Energy.</i>	Index Journal (Q2 IF 4.084)
17.	T3A-17	2017	Nur Izzati Iberahim, Jamaliah Md Jahim, Peer Mohamed Abdul  Tabassum Mumtaz	Effect of Initial Substrate Concentration and pH on Bio Hydrogen Fermentation from Oil Palm Mesocarp Fiber (OPMF) Hydrolysate in Batch Fermentation. <i>Science International.</i>	Index Journal (Q1 IF 1.990)
18.	T3A-18	2016	Mariatul Fadzillah Mansor, Jamaliah Md Jahim, T. Mumtaz, Rakmi Abd Rahman, Sahilah Abd. Mutalib	Development of a methane-free, continuous biohydrogen production system from palm oil mill effluent (Pome) in CSTR. <i>Journal Engineering Science and Technology.</i>	Index Journal (Q1 IF 4.084)



19.	T3A-19	2016	Peer Mohamed Abdul, Jamaliah Md Jahim, Shuhaida Harun, Masturah Markom, Nabilah Aminah Lutpi, Osman Hassan, Venkatesh Balan, Bruce E Dale, Mohd Tusirin Mohd Nor	Effects of changes in chemical and structural characteristic of ammonia fibre expansion (AFEX) pretreated oil palm empty fruit bunch fibre on enzymatic saccharification and fermentability for biohydrogen. <i>Bioresource Technology</i> .	Index Journal (Q1 IF 6.669)
20.	T3A-20	2016	Nabilah Aminah Lutpi, Jamaliah Md Jahim, T. Mumtaz, Shuhaida Harun, Peer Mohamed Abdul	Batch and continuous thermophilic hydrogen fermentation of sucrose using anaerobic sludge from palm oil mill effluent via immobilisation technique. <i>Process Biochemistry</i> .	Index Journal (Q1 IF 2.883)
21.	T3A-21	2015	Nabilah Aminah Lutpi, Jamaliah Md Jahim, T. Mumtaz, Peer Mohamed Abdul, Mohd Tusirin Mohd Nor	Physicochemical characteristics of attached biofilm on granular activated carbon for thermophilic biohydrogen production. <i>RSC Advances</i>	Index Journal (Q1 IF 3.049)
22.	T3A-22	2013	Peer Mohamed Abdul, Jamaliah Md Jahim, Shuhaida Harun, Masturah Markom, Osman Hassan, Abdul Wahab Mohammad, Ahmad Jaril Asis	Biohydrogen production from pentose-rich oil palm empty fruit bunch molasses: a first trial. <i>International journal of hydrogen energy</i>	Index Journal (Q2 IF 4.084)
23.	T3A-23	2012	Nur Athirah Khaleb., Jamaliah Md Jahim & Sameer Kamal	Biohydrogen production using hydrolysates of palm oil mill effluent (POME). <i>Journal of Asian Scientific Research</i> .	Index Journal (Q2 IF 0.381)

Table 5.4 List of Publication Thrust Area 3B

No.	Softcopy	Year	Author	Title	Journal / Proceeding
1.	T3B-1	2020	Manoj Pudukudy, Zahira Yaakob, Khaleeda Mhd Syahri, Qingming Jia, Shaoyun Shan	Production of hydrogen-rich syngas and multiwalled carbon nanotubes by biogas decomposition over zirconia supported iron catalysts. <i>Journal of Industrial and Engineering Chemistry</i> .	Index Journal (Q1 IF 4.978)
2.	T3B-2	2019	Manoj Pudukudy, Zahira Yaakob, Qingming Jia, Mohd Sobri Takriff	Catalytic decomposition of methane over rare earth metal (Ce and La) oxides supported iron catalysts. <i>Applied Surface Science</i> 467-468: 236-248.	Index Journal (Q1 IF 5.115)
3.	T3B-3	2018	Sharifah Najiha Badar, Masita Mohammad, Zeynab Emdadi, Zahira Yaakob	Algae and their growth requirements for bioenergy: a review : 1-19. <i>Biofuels</i> .	Index Journal (Q2 IF 1.130)
4.	T3B-4	2018	Norhasyimi Rahmat, Zahira Yaakob, Manoj Pudukudy, Norazah Abdul Rahman, Seri Suriani Jahaya	Single step solid-state fusion for MgAl <sub>2</sub> O <sub>4</sub> spinel synthesis and its influence on the structural and textural properties. <i>Powder Technology</i> 329 : 409-419.	Index Journal (Q1 IF 3.413)
5.	T3B-5	2018	Manoj Pudukudy, Zahira Yaakob, Qingming Jia, Mohd Sobri Takriff	Catalytic decomposition of undiluted methane into hydrogen and carbon nanotubes over Pt promoted Ni/CeO <sub>2</sub> catalysts. <i>New Journal of Chemistry</i>	Index Journal (Q2 IF 3.069)
6.	T3B-6	2017	Manoj Pudukudy, Zahira Yaakob, Abudukeremu Kadier, Mohd Sobri Takriff, Nik Suhaimi Mat Hassan.	One-pot sol-gel synthesis of Ni/TiO <sub>2</sub> catalysts for methane decomposition into CO <sub>x</sub> free hydrogen and multiwalled carbon nanotubes. <i>International Journal of Hydrogen Energy</i> 42(26): 16495-16513.	Index Journal (Q2 IF 4.084)

7.	T3B-7	2017	Manoj Pudukudy, Zahira Yaakob, Nursyifaa' Dahani, Mohd Sobri Takriff, Nik Suhaimi Mat Hassan	Production of CO <sub>x</sub> Free Hydrogen and Nanocarbon via Methane Decomposition Over Unsupported Porous Nickel and Iron Catalysts. <i>Journal of Cluster Science</i> 28 (3) : 1579-1594.	Index Journal (Q3 IF 2.125)
8.	T3B-8	2017	Sharifah Najiha Badar, Zahira Yaakob, Sharifah Najiha Timmiati	Growth evaluation of microalgae isolated from palm oil mill effluent in synthetic media. <i>Malaysian Journal of Analytical Sciences</i> 21(1): 82-94.	Journal Scopus (Q4)
9.	T3B-9	2017	Rahima Khatun, Mohammad Imam Hasan Reza, Md. Moniruzzaman, Zahira Yaakob	Sustainable oil palm industry: The possibilities. <i>Renewable and Sustainable Energy Reviews</i> 76 : 608-619.	Index Journal (Q1 IF 10.556)
10.	T3B-10	2016	Manoj Pudukudy, Zahira Yaakob, Mohd Sobri Takriff	Methane decomposition over unsupported mesoporous nickel ferrites: Effect of reaction temperature on the catalytic activity and properties of the produced nanocarbon. <i>RSC Advances</i> 6(72): 68081-68091.	Index Journal (Q2 IF 3.049)
11.	T3B-11	2016	Manoj Pudukudy, Abudukeremu Kadier, Zahira Yaakob, Mohd Sobri Takriff	Non-oxidative thermocatalytic decomposition of methane into CO <sub>x</sub> free hydrogen and nanocarbon over unsupported porous NiO and Fe <sub>2</sub> O <sub>3</sub> catalysts. <i>International Journal of Hydrogen Energy</i> 41(41): 18509-18521.	Index Journal (Q1 IF 4.084)
12.	T3B-12	2016	Manoj Pudukudy, Zahira Yaakob, Mohd Sobri Takriff	Methane decomposition into CO <sub>x</sub> free hydrogen and multiwalled carbon nanotubes over ceria, zirconia and lanthana supported nickel catalysts prepared via a facile	Index Journal (Q1 IF 7.181)

				solid state citrate fusion method. <i>Energy Conversion and Management</i> 126: 302-315.	
13.	T3B-13	2016	Nurul Zafirah Abd.Khalim Khafidz, Zahira Yaakob, Kean Long Lim, Sharifah Najiha Timmiati	The kinetics of lightweight solid-state hydrogen storage materials: A review. <i>International Journal of Hydrogen Energy</i> 41(30) : 13131-13151.	Index Journal (Q1 IF 4.084)
14.	T3B-14	2015	Manoj Pudukudy Zahira Yaakob.	Methane decomposition over Ni, Co and Fe based monometallic catalysts supported on sol gel derived SiO <sub>2</sub> microflakes. <i>Chemical Engineering Journal</i> 262:1009-1021.	Index Journal (Q1 IF 8.355)
15.	T3B-15	2015	Manoj Pudukudy, Zahira Yaakob , Zubair Shamsul Akmal.	Direct decomposition of methane over SBA-15 supported Ni, Co and Fe based bimetallic catalysts. <i>Applied Surface Science</i> 330:418-430.	Index Journal (Q1 IF 5.155)
16.	T3B-16	2014	Manoj Pudukudy, Zahira Yaakob, Ramesh Rajendran.	Facile synthesis of mesoporous Mn <sub>2</sub> O <sub>3</sub> microspheres via morphology conserved thermal decomposition of MnCO <sub>3</sub> microsphere. <i>Materials Letters</i> 136: 85-89.	Index Journal (Q2 IF 3.019)
17.	T3B-17	2014	Manoj Pudukudy, Zahira Yaakob, Binitha Narayanan.	Selective vapour Phase oxidation of benzyl alcohol to benzaldehyde over mesoporous ceria-zirconia solid solution synthesized via facile citrate route. <i>Journal of Cluster Science</i> 25(6):1599-1614.	Index Journal (Q3 IF 2.125)

18.	T3B-18	2014	Renganathan Rajkumar, Zahira Yaakob, Mohd Sobri Takriff	Potential of the Micro and Macro Algae for Biofuel Production-A Brief Review. <i>BioResources</i>	Index Journal 1.396 Q2
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Table 5.5 List of Publication Thrust Area 4

No.	Soft Copy	Year	Author	Title	Journal / Proceeding
1.	T4-1	2019	Aqilah Mohd Tajuddin, Shuhaida Harun, Mohd Shaiful Sajab, Saiful Irwan Zubairi, Jamaliah Md Jahim, Masturah Markom, Mohd Tusirin Mohd Nor, Mohd Amrin Abdullah, Norhafizi Hashim.	Influence of Deep Eutectic Solvent (DES) Pretreatment on Various Chemical Composition of Empty Fruit Bunch (EFB). <i>International Journal of Engineering &amp; Technology</i> .	Journal Scopus (Q4)
2.	T4-2	2018	Azuan Abdul Latif, Shuhaida Harun, Mohd Shaiful Sajab, Masturah Markom and Jamaliah Md Jahim.	Ammonia-based Pretreatment For Ligno-cellulose Biomass Conversion – An Overview. <i>Journal of Engineering Science and Technology</i> .	Journal Scopus (Q2)
3.	T4-3	2018	Nur Farahin Abdul Rahman, Shuhaida Harun, Mohd Shaiful Sajab, Saiful Irwan Zubairi, Masturah Markom, Jamaliah Md Jahim, Mohd Tusirin Mohd Nor, Mohd Amrin Abdullah, Norhafizi Hashim.	Boosting enzymatic hydrolysis of pressurized ammonium hydroxide pretreated empty fruit bunch using response surface methodology. <i>Journal of Engineering Science and Technology</i> .	Journal Scopus (Q2)

4.	T4-4	2016	Nurul Hazirah Che Hamzah, Masturah Markom, Shuhaida Harun, Osman Hassan	The effect of various pretreatment methods on empty fruit bunch for glucose production. <i>Malaysian Journal of Analytical Sciences</i>	Q4
5.	T4-5	2016	Nurul Aina Fauzi, Shuhaida Harun, Jamaliah Md Jahim	Physiochemical changes and mass balance of raw and alkaline pretreated oil palm frond: Pressed versus non-pressed sample. <i>International Journal of Applied Engineering Research</i>	Q3
6.	T4-6	2015	Nur Atikah Md Nor , Wan Aida Wan Mustapha , Osman Hassan	Deep Eutectic Solvent (DES) As A Pretreatment For Oil Palm Empty Fruit Bunch (OPEFB) In Sugar Production. <i>Procedia Chemistry.</i>	Conference Proceeding
7.	T4-7	2015	Nursyafiqah Zulkiple , Mohamad Yusuf Maskat , Osman Hassan	Pretreatment Of Oil Palm Empty Fruit Fiber (OPEFB) With Aqueous Ammonia For High Production Of Sugar. <i>Procedia Chemistry.</i>	Conference Proceeding
8.	T4-8	2015	Hemavathi Silvamany, Shuhaida Harun, Tabassum Mumtaz, Jamaliah Md Jahim	Recovery of fermentable sugars from palm oil mill effluent via enzymatic hydrolysis. <i>Jurnal Teknologi</i>	Journal Scopus (0.18 Q2)
9.	T4-9	2015	Nurul Hazirah Che Hamzah, Masturah Markom, Osman Hassan, Shuhaida Harun	Investigation of the Effect of Supercritical Carbon Dioxide Pretreatment on Sugar Yield Prior to Enzymatic Hydrolysis of Empty Fruit Bunches. <i>Industrial Biotechnology</i>	Journal Scopus (Q3)
10.	T4-10	2014	Nurul Hazirah, Che Hamzah, Markom Masturah, Hassan Osman, M Jahim Jamaliah, Harun Shuhaida	Preliminary study on analysis of the Chemical compositions and characterization of Empty Fruit Bunch (EFB) in Malaysia. <i>Advanced Materials Research</i>	Journal Scopus (Q4)

Table 5.6 List of Publication Thrust Area 5

No.	Soft Copy	Year	Author	Title	Journal / Proceeding
1.	T5-1	2020	Jannatulhawa Jasni, Shalini Narayanan Arisht, Nazlina Haiza Mohd Yasin, Peer Mohamed Abdul, Sheng-Kai Lin, Chun-Min Liu, Shu-Yii Wu, Jamaliah Md Jahim, Mohd Sobri Takriff	Comparative toxicity effect of organic and inorganic substances in palm oil mill effluent (POME) using native microalgae species. <i>Journal of Water Process Engineering</i>	Index Journal (Q1 IF 3.173)
2.	T5-2	2019	Harizah Bajunaid Hariz,, Mohd Sobri Takriff, Nazlina Haiza Mohd Yasin, Muneer M Ba-Abbad, Noor Irma Nazashida Mohd Hakimi	Potential of the microalgae-based integrated wastewater treatment and CO <sub>2</sub> fixation system to treat Palm Oil Mill Effluent (POME) by indigenous microalgae; <i>Scenedesmus sp.</i> and <i>Chlorella sp.</i> <i>Journal of Water Process Engineering</i>	Index Journal (Q1 IF 3.173)
3.	T5-3	2019	Azianabiha A Halip Khalid, Zahira Yaakob, Siti Rozaimah Sheikh Abdullah, Mohd Sobri Takriff	Analysis of the elemental composition and uptake mechanism of <i>Chlorella sorokiniana</i> for nutrient removal in agricultural wastewater under optimized response surface methodology (RSM) conditions. <i>Journal of Cleaner Production</i>	Index Journal (Q1 IF 6.395)
4.	T5-4	2019	Azianabiha A Halip Khalid, Zahira Yaakob, Siti Rozaimah Sheikh Abdullah, Mohd Sobri Takriff	Assessing the feasibility of microalgae cultivation in agricultural wastewater: The nutrient characteristics. <i>Environmental Technology &amp; Innovation</i>	Index Journal (Q2 IF 2.8)
5.	T5-5	2018	Nur Anira Syafiqah Hazman, Nazlina Haiza Mohd Yasin, Mohd Sobri Takriff, Hassimi Abu Hassan, Kamrul	Integrated Palm Oil Mill Effluent Treatment and CO <sub>2</sub> Sequestration by Microalgae. <i>Sains Malaysiana</i>	Index Journal (Q2 IF 0.565)

			Fakir Kamarudin & Noor Irma Nazashida Mohd Hakimi. 2018.		
6.	T5-7	2018	Azianabiha A Halip Khalid, Zahira Yaakob, Siti Rozaimah Sheikh Abdullah, Mohd Sobri Takriff	Growth improvement and metabolic profiling of native and commercial <i>Chlorella sorokiniana</i> strains acclimatized in recycled agricultural wastewater. <i>Bioresource Technology</i> .	Index Journal (Q1 IF 6.669)
7.	T5-8	2017	Ainil Farhan Mohd Udaiyappan, Hassimi Abu Hasan, Mohd Sobri Takriff, Siti Rozaimah Sheikh Abdullah	A review of the potentials, challenges and current status of microalgae biomass applications in industrial wastewater treatment. <i>Journal of Water Process Engineering</i> 20:8-21.	Index Journal (Q1 IF 3.173)
8.	T5-9	2017	Azima Syafaini Japar, Nur Mutmainnah Azis, Mohd. Sobri Takriff, Nazlina Haiza Mohd Yasin	Application of Different Techniques to Harvest Microalgae. <i>Transactions on Science and Technology</i>	Jounal Non Index
9.	T5-10	2017	Azima Syafaini Japar, Mohd Sobri Takriff, Jamaliah Md Jahim, Abdul Amir H. Kadhum	The Effect of Glucose Addition in Acetone-Butanol-Ethanol (ABE) Fermentation from Palm Oil Mill Effluent (POME) By <i>Clostridium Acetobutylicum</i> NCIMB 619. <i>Malaysian Journal of Analytical Sciences</i>	Index Journal Q4
10.	T5-11	2017	Azima Syafaini Japar, Mohd Sobri Takriff, Nazlina Haiza Mohd Yasin	Harvesting microalgal biomass and lipid extraction for potential biofuel production: A review. <i>Journal of Environmental Chemical Engineering</i>	Index Journal Q1
11.	T5-11	2017	Harizah Bajunaid Hariz, Mohd Sobri Takriff	Palm oil mill effluent treatment and CO <sub>2</sub> sequestration by using microalgae—sustainable strategies for	Index Journal (Q2 IF 2.8)



				environmental protection. <i>Environmental Science and Pollution Research</i> 24(25): 20209-20240	
12.	T5-12	2017	Harizah Bajunaid Hariz, Mohd Sobri Takriff	Growth and Biomass Production of Native Microalgae <i>Chlorella sp.</i> , <i>Chlamydomonas sp.</i> and <i>Scenedesmus sp.</i> Cultivated in Palm Oil Mill Effluent (POME) at Different Cultivation Conditions. <i>Transactions on Science and Technology</i>	Scopus Non Index
13.	T5-13	2017	Harizah Bajunaid Hariz & Mohd Sobri Takriff & Muneer M. Ba-Abbad & Nazlina Haiza Mohd Yasin & Noor Irma Nazashida Mohd Hakim	CO <sub>2</sub> fixation capability of <i>Chlorella sp.</i> and its use in treating agricultural wastewater. <i>Journal of Applied Phycology</i>	Index Journal (Q1 IF 2.635)
14.	T5-14	2017	Norzila Mohd, Mohd Sobri Takriff, Sarifah Fauziah Syed Draman	Nutrients assessment of anaerobic palm oil mill effluent (AnPOME) as an alternative media for microalgae culture. <i>Journal of Fundamental and Applied Sciences</i>	Jounal NonIndex
15.	T5-15	2017	Muhammad Nazry Chik, Liyana Yahya, Kamrul Fakir Kamarudin, Ding Gong Tao, Mohd Sobri Takriff	Isolation, purification and identification of microalgae from coal-fired power plant environment. <i>Malaysian Journal of Analytical Sciences</i>	Index Journal Q4
16.	T5-16	2016	Muhammad Nazry Chik, Liyana Yahya, Afifi Zainal, Kamrul Fakir Kamarudin, Ding Tao, Mohd Sobri Takriff	Tackling Carbon Emission with Nature: Effectiveness of Indigenous Microalgae Mixed Culture. <i>MATEC Web of Conferences</i> .	Conferences

17.	T5-17	2016	Mohd Sobri Takriff, Muhamad Zuhairi Zakaria, Mohd Shaiful Sajab, Yeit Haan Teow.	Pre-treatments Anaerobic Palm Oil Mill Effluent (POME) for Microalgae Treatment. <i>Indian Journal of Science and Technology</i> .	Journal Scopus
18.	T5-18	2016	Gong Tao Ding ,Zahira Yaakob , Mohd Sobri Takriff, Jailani Salihon, Muhammad Syukri Abd Rahaman	Biomass production and nutrients removal by a newly-isolated microalgal strain <i>Chlamydomonas</i> sp in palm oil mill effluent (POME). <i>International Journal OF Hydrogen Energy</i> .	Index Journal (Q2 IF 4.034)
19.	T5-19	2016	Zuraifah Bt. Minhat, Muhammad Syukri B. Ab Rahaman, Mohd S. Takriff, Noorhisham T. Kofli	Differentiation of biomass composition between Isolated and commercial strains of microalgae. <i>Journal of Engineering Science and Technology</i>	Index Journal Q2
20.	T5-20	2016	Azianabiha A Halip Khalid, Zahira Yaakob, Siti Rozaimah Sheikh Abdullah, Mohd Sobri Takriff	Enhanced growth and nutrients removal efficiency of <i>Characium</i> sp. cultured in agricultural wastewater via acclimatized inoculum and effluent recycling. <i>Journal of Environmental Chemical Engineering</i> 4(3): 3426-3432.	Index Journal (Q1 IF 1.198)
21.	T5-21	2015	Kamrul Fakir Kamarudin, Ding Gong Tao, Zahira Yaakob, Mohd Sobri Takriff, Muhammad Syukri Abd Rahaman, Jailani Salihon	A review on wastewater treatment and microalgal by-product production with a prospect of palm oil mill effluent (POME) utilization for algae. <i>Der Pharma Chemica</i> 7.	Journal Scopus Q2
22.	T5-22	2015	Ruth Rajkumar, Mohd Sobri Takriff	Nutrient removal from anaerobically treated palm oil mill effluent by <i>Spirulinaplantensis</i> and <i>Scenedesmusdimorphus</i> . <i>Der Pharmacia Lettre</i> 7 (7): 416-421.	Journal Scopus Q2

23.	T5-23	2015	Tamilarasi B Tamil Selvam , Rajkumar Renganathan , Mohd Sobri Takriff	Nutrient Removal of POME using POME isolated microalgae strain, Characium sp. <i>Advanced Materials Research</i>	Index Journal Q4
24.	T5-24	2014	Mohd Sobri Takriff, Nur Azua Liyana Jaafar, Siti Rozaimah Sheikh Abdullah,	A Review of Biofilm Treatment Systems in Treating Downstream Palm Oil Mill Effluent (POME). <i>Journal of Applied Sciences</i>	Index Journal Q3
25.	T5-25	2013	Kamrul Fakir Kamarudin, Zahira Yaakob, Renganathan Rajkumar , Mohd Sobri Takriff,and Siti Masrinda Tasirin	Bioremediation of Palm Oil Mill Effluents (POME) Using <i>Scenedesmus dimorphus</i> and <i>Chlorella vulgaris</i> . <i>Advanced Science Letters</i>	Index Journal (Q3 IF 1.253)
26.	T5-26	2012	Afifi Zainal, Zahira Yaakob, Mohd Sobri Takriff, Renganathan Rajkumar and Jaharah Abdul Ghani	Phycoremediation in Anaerobically Digested Palm Oil Mill Effluent Using Cyanobacterium, <i>Spirulina platensis</i> . <i>Biobased Materials and Bioenergy</i>	Index Journal (Q2 IF 2.993)
27.		2020	Ainil Farhan Mohd Udaiyappan, Hassimi Abu Hasan, Mohd Sobri Takriff, Siti Rozaimah Sheikh Abdullah, Toshinari Maeda, Nurul Asyifah Mustapha, Nazlina Haiza Mohd Yasin, Noor Irma Nazashida Mohd Hakimi	Microalgae-bacteria interaction in palm oil mill effluent treatment. <i>Journal of Water Process Engineering</i>	Index Journal (Q1 IF 3.173)
28.	T5-28	2020	Gong Tao Ding, Nazlina Haiza Mohd Yasinb, Mohd Sobri Takriff, Kamrul Fakir Kamarudin,Jailani Salihon, Zahira Yaakob, Noor Irma Nazashida Mohd Hakimi	Phycoremediation of palm oil mill effluent (POME) and CO <sub>2</sub> fixation by locally isolated microalgae: <i>Chlorella sorokiniana</i> UKM2, <i>Coelastrella sp.</i> UKM4 and <i>Chlorella pyrenoidosa</i> UKM7. <i>Journal of Water Process Engineering</i>	Index Journal (Q1 IF 3.173)

Table 5.7 List of Publication Thrust Area 6

No.	Soft Copy	Year	Author	Title	Journal / Proceeding
1.	N/A	2019	Siti Nur Hatika Abu Bakar, Hassimi Abu HAsan, Abdul Wahab Mohammad	Pengurusan Sisa Kilang Sawit	Book Penerbit UKM UKM Press
2.	T6-2	2019	Woon Chan Chong, Abdul Wahab Mohammad, Ebrahim Mahmoudi, Ying Tao Chung, Kamrul Fakir Kamarudin, Mohd Sobri Takriff	Nanohybrid membrane in algal-membrane photoreactor: Microalgae cultivation and wastewater polishing. <i>Chinese Journal of Chemical Engineering</i>	Index Journal (Q3 IF 1.911)
3.	T6-3	2019	Yeit Haan Teow, Nadzirah Ilyiani Nordin, Abdul Wahab Mohammad	Green synthesis of palm oil mill effluent-based graphenic adsorbent for the treatment of dye-contaminated wastewater. <i>Environmental Science and Pollution Research</i>	Index Journal (Q1 IF 2.914)
4.	T6-4	2019	Ho Kah Chun, Yeit Haan Teow, Abdul Wahab Mohammad	Optimization of nanocomposite conductive membrane formulation and operating parameters for electrically-enhanced palm oil mill effluent filtration using response surface methodology. <i>Process Safety and Environmental Protection</i>	Index Journal (Q1 IF 4.384)
5.	T6-5	2018	Teow Yeit Haan, Zhong Huo Wong, Mohd Sobri Takriff, Abdul Wahab Mohammad	Fouling behaviours of two stages microalgae/membrane filtration system applied to palm oil mill effluent treatment. <i>Membrane Water Treatment</i> 9(5): 373-383	Index Journal (Q4 IF 0.975)

6.	T6-6	2018	Mohd Syahmi Hafizi Ghani, Teow Yeit Haan, Ang Wei Lun, Abdul Wahab Mohammad, Rahmat Ngteni, Khairul Muis Mohamed Yusof.	Fouling assessment of tertiary palm oil mill effluent (Pome) membrane treatment for water reclamation. <i>Journal of Water Reuse and Desalination</i> 8(3) 412-423.	Index Journal (Q3 IF 1.538)
7.	T6-7	2018	Teow Yeit Haan, Mohd Syahmi Hafizi Ghani, Abdul Wahab Mohammad..	Physical and Chemical Cleaning for Nanofiltration/Reverse Osmosis (NF/RO) Membranes in Treatment of Tertiary Palm Oil Mill Effluent (POME) for Water Reclamation. <i>Jurnal Kejuruteraan</i> .	Non Index Journal
8.	T6-8	2018	Wan Nur Athirah Wan Mohammad Hamdan, Teow Yeit Haan, Abdul Wahab Mohammad. 2018.	Sustainable Approach in Palm Oil Industry–Green Synthesis of Palm Oil Mill Effluent Based Graphene Sand Composite (P-GSC) for Aerobic Palm Oil Mill Effluent Treatment. <i>Jurnal Kejuruteraan</i> .	Non Index Journal
9.	T6-9	2018	Ho Kah Chun, Teow Yeit Haan. Abdul Wahab Mohammad, Ang Wei Lun, Lee Pak Hoe. 2018.	Development of Graphene Oxide (GO)/Multi-walled Carbon Nanotubes (MWCNTs) Nanocomposite Conductive Membranes for Electrically Enhanced Fouling Mitigation. <i>Journal of Membrane Science</i> 552: 189-201.	Index Journal (Q1 IF 7.015)
10.	T6-10	2018	Ho Kah Chun, Yeit Haan Teow, Abdul Wahab Mohammad	Optimization of Nanocomposite Conductive Membrane and Operating Parameters for Electrically Enhanced Palm Oil Mill Effluent (POME) Filtration Using Response Surface Methodology (RSM). <i>In 11th International Conference in Challenges in Environmental Science &amp; Engineering (CESE 2018), Bangkok, Thailand</i> .	Conference Proceeding

11.	NA	2018	Teow Yeit Haan, Abdul Wahab Mohammad, Siti 'Aisyah Tajudin, Ho Kah Chun.	Sustainable Practice on The Development of Graphenic Adsorbent from Palm Oil Industry Biomass for Textile Industry Wastewater Treatment. <i>In 11th International Conference in Challenges in Environmental Science &amp; Engineering (CESE 2018), Bangkok, Thailand.</i>	Conference Proceeding
12.	T6-12	2018	Siti Nur Hatika Abu Bakar, Hassimi Abu Hasan, Abdul Wahab Mohammad, Siti Rozaimah Sheikh Abdullah, Teow Yeit Haan, Rahmat Ngteni and Khairul Muis Mohamed. 2018.	A Review of Moving-bed Biofilm Reactor Technology for Palm Oil Mill Effluent Treatment. <i>Journal of Cleaner Production</i> 171: 1532-1545.	Index Journal (Q1 IF 6.395)
13.	T6-13	2017	Woon Chan Chong, Ebrahim Mahmoudi, Ying Tao Chung, Chai Hoon Koo, Abdul Wahab Mohammad, Kamrul Fakir Kamarudin. 2017.	Improving Performance in Algal Organic Matter Filtration using Polyvinylidene Fluoride Graphene Oxide Nanohybrid Membranes. <i>Algal Research</i> 11(27): 32-42.	Index Journal (Q1 IF 3.723)
14.	T6-14	2017	Ho Kah Chun, Teow Yeit Haan, Ang Wei Lun, Abdul Wahab Mohammad. 2017.	An Overview of Electrically-enhanced Membrane Bioreactor (EMBR) for Fouling Suppression. <i>Journal of Engineering Science and Technology Review</i> 10(3): 128-138.	Journal Scopus Q2
15.	T6-15	2017	Ho Kah Chun, Teow Yeit Haan, Ang Wei Lun, Abdul Wahab Mohammad. 2017.	Novel GO/ OMWCNTs Mixed-matrix Membrane with Enhanced Antifouling Property for Palm Oil Mill Effluent Treatment. <i>Separation and Purification Technology</i> 177: 337-349.	Index Journal (Q1 IF 5.137)

16.	T6-16	2017	Ho Kah Chun, Yeit Haan Teow, Abdul Wahab Mohammad	Enhanced Electrical Conductivity of Polymeric Membrane by Blending Hybrid Graphene Oxide and Multi-Walled Carbon Nanotubes. <i>In Tuanku Ja'afar Conference (TJC) 2017 Governance Towards Sustainable Development Goals, Selangor, Malaysia.</i>	Conference Proceeding
17.	T6-17	2017	Muhammad Said, Muneer M Ba-Abbad, Siti Rozaimah Sheikh Abdullah, Abdul Wahab Mohammad	Application of response surface method in reverse osmosis membrane to optimize BOD, COD and colour removal from palm oil mill effluent. <i>International Journal on Advanced Science, Engineering and Information Technology</i>	Index Journal Q2
18.	T6-18	2016	Raheek I. Ibrahim, Abdul Wahab Mohammad, Zheng Hua Wong	Optimization of POME treatment process using microalgae and ultrafiltration. <i>Membrane Water Treatment</i> 6 (4): 293-308.	Index Journal (Q4 IF 0.975)
19.	T6-19	2016	Teow Yeit Haan, Abdul Wahab Mohammad, Wan Nur Athirah Wan, Mohammad Hamdan, Mohd Syahmi Hafizi Ghani, Rahmat Ngteni, Khairul Muis Mohamed Yusof. 2016.	Pilot-scale integrated pretreatment/membrane filtration system for aerobic palm oil Mill effluent (POME) treatment. <i>The 2016 World Congress on Advanced in Civil, Environmental and Material Research (ACEM16), Jeju Island, Korea.</i>	Conference Proceeding
20.	T6-20	2016	Muhammad Said, Hassimi Abu Hasan, Mohd Tusirin Mohd Nor, Abdul Wahab Mohammad. 2016.	Removal of COD, TSS and Colour from Palm Oil Mill Effluent (POME) using Montmorillonite. <i>Desalination and Water Treatment</i> 57(23): 10490-10497.	Index Journal (Q3 IF 1.234)
21.	T6-21	2016	Muhammad Said, Siti Rozaimakh Sheikh Abdullah, Abdul Wahab Mohammad	Palm Oil Mill Effluent Treatment through Combined Process Adsorption and Membrane Filtration. <i>Sriwijaya Journal of Environment</i>	Journal Scopus Non index

22.	T6-22	2016	Muhammad Said, Muneer M. Ba-Abbad, Abdul Wahab Mohammad	Optimization of Palm Oil Mill Effluent Treatment by Applying RSM and ANN. <i>Indonesian Journal of Fundamental and Applied Chemistry</i> .	Non Index
23.	T6-23	2015	Muhammad Said, Akil Ahmad, Abdul Wahab Mohammad, Mohd Tusirin Mohd Nor, Siti Rozaimah Sheikh Abdullah	Blocking mechanism of PES membrane during ultrafiltration of POME. <i>Journal of Industrial and Engineering Chemistry</i> 21: 182-188.	Index Journal (Q1 IF 4.978)
24.	T6-24	2015	Muhammad Said, Abdul Wahab Mohammad, Mohd Tusirin Mohd Nor, Siti Rozaimah Sheikh Abdullah, Hassimi Abu Hasan. 2015.	Investigation of three pre-treatment methods prior to nanofiltration membrane for palm oil mill effluent treatment. <i>Sains Malaysiana</i> 44(3): 421-427.	Index Journal (Q4 IF 0.54)
25.	T6-25	2015	Abdul Wahab Mohammad, Yeit Haan Teow, Wei Lun Ang, Ying Tao Chung, Darren L. Oatley-Radcliffe, Nidal Hilal	Nanofiltration membranes review: Recent advances and future prospects. <i>Desalination</i>	Index Journal (Q1 IF 6.035)
26.	T6-26	2014	Muhammad Said, Abdul Wahab Mohammad, Mohd Tusirin Mohd Nor, Siti Rozaimah Sheikh Abdullah, Hassimi Abu Hasan	Chemical cleaning of fouled polyethersulphone membranes during ultrafiltration of palm oil mill effluent. <i>Membrane Water Treatment</i>	Index Journal (Q4 IF 0.975)



Table 5.8 Summary of research publications by index and collaboration type

Publication type with indexed (SCOPUS/WOS)	T1	T2	T3A	T3B	T4	T5	T6	TOTAL
Journal Q1	3		15	9		11	8	<b>46</b>
Journal Q2	2		6	6	3	6	2	<b>25</b>
Journal Q3	2			2	2	3	3	<b>12</b>
Journal Q4				1	3	3	4	<b>11</b>
Non-Index Journal	8	2				4	4	<b>18</b>
Proceeding	2	6	2		2	1	4	<b>17</b>
Book							1	<b>1</b>
<b>TOTAL</b>	<b>17</b>	<b>8</b>	<b>23</b>	<b>18</b>	<b>10</b>	<b>28</b>	<b>26</b>	<b>130</b>

Table 5.9 Summary of research publications by collaboration

COLABORATION	T1	T2	T3A	T3B	T4	T5	T6
SDR			4		2	5	3
PROF WU	2		5			1	
PROF CLASSEN	1						

