



# ABSTRACT BOOK and SEMINAR PROGRAM

2<sup>nd</sup> **ICBEAU**

**International Conference of Bio-Based Economy  
for Application and Utilization**

Via Zoom Meeting on December 16<sup>th</sup>, 2020



# **Welcome Address by The Head of LPPM in Andalas University**

Assalamu'alaikum wr. wb,

Good morning to all of you.

Dear respected keynote speakers

Members of the organizing committee

Dear participants and observers

Distinguished guests, respected colleagues, ladies, and gentlemen

We are very happy to welcome all participants of the International Conference on Bio-Based Economy for Application and Utilization (ICBEAU-2020). This conference has a very strategic position in responding the global development. Need on an agricultural product is not dominated currently in food aspect, but is becoming more broadly to the new aspect beyond the food. Fossil based energy currently contributed to many pollution issues in the whole of the world, beside its existence which is more scarce in the future. Drug development, based on synthetic chemicals and materials is believed and regarded plays a significant role in the occurring of new health problem and disease. For that reason, a shifting in medical treatment back to nature is becoming a trend nowadays. Thus, this ICBEAU-2020, should have a very significant impact on the above-mentioned issues.

Respected Ladies and Gentlemen

As the Head of LPPM in Andalas University, I personally very support to this event. We thanks to all parties supporting and contributing to implementing this International Conference.

Especially I would like to thank for all keynote speakers who responded positively our request to share their insight, experience, and expertise in this conference.

- Prof. Dr. Inez H. Slamet Loedin from International Rice Research Institute, Philippines
- dr. Rauza Sukma Rita, Ph.D from Andalas University, Indonesia
- Assoc. Prof. Dr. Pasupuleti Visweswara Rao from Universiti Malaysia Sabah, Malaysia
- Asst. Prof. Saowakon Wattanachant, Ph.D from Prince of Songkla University, Thailand
- Dr. Rosewine Joy from Presidency University, India

And who kindly join this seminar and share their experience and expertise in this conference.

Finally, I would like to congratulate the organizing committee for their tremendous efforts in organizing the conference.

Success for all of us,

Head of the LPPM in  
Andalas University,  
Dr.-Ing. Ir. Uyung Gatot Syafrawi Dinata, M.T.



## **Welcoming Speech of The Committee's Chairman**

### **Good Morning, ladies and gentlemen,**

On behalf of the committee, first of all let me welcome you and express our great thanks for participating in this 2<sup>nd</sup> International Conference of Bio-Based Economy for Application and Utilization 2020 (ICBEAU-2020).

Nowadays, we are still facing the CoVID-19 pandemic issue, which is significantly impact our activities and thus also our lifestyle as well. Many economic sectors are now facing difficult situation and force them to shift their work into an adaptive condition, otherwise they will suffer or fail to survive. However, this difficult situation on the other sides provide many opportunities particularly in the application and utilization of bio-based drugs and materials. In this context, this seminar event of the 2<sup>nd</sup> ICBEAU 2020 should meet its relevancies and urgencies.

### **Dear honored participants,**

In this opportunity let me sound my great thanks to all parties involving and contributing to the implementation of this seminar. Special thanks to our respected keynote speakers; Prof. Dr. Inez H. Slamet Loedin. from International Rice Research Institute, Philippines; dr, Rauza Sukma Rita, Ph.D from Andalas University; Assoc. Prof Dr Pasupuleti Visweswara Rao from Universiti Malaysia Sabah, Malaysia; Asst Prof Saowakon Wattanachant Ph D, from Prince of Songkla University Thailand and Dr. Rosewine Joy, Presidency University India -for their collaboration and their kindness to share their experience and their expertise in this forum. Many, many thanks also addressed to the Rector of Andalas University and head of Institution of Research and Community Service of Andalas University, Dr. Uyung Gatot also all parties and valuable participants that could not be mentioned in this opportunity.

Finally, we hope this seminar could bring a significant impact and contribution to the future application and utilization of Bio-Based economy.

Regards,

Chairman of the Committee

Prof. Dr.sc.agr. Ir. Jamsari, MP.



# Committee Structure

## International Conference on Bio-Based Economy for Application and Utilization (ICBEAU) 2020

### Organizing Committee:

**Chairman** : Prof. Dr. sc. agr. Jamsari

**Secretariate** : Raudhatul Fatiah, SP. M. Biotek  
Lily Syukriani, SP, M.Si  
Nur Ainun Hamzah  
Nurefni Azizah

**Treasury** : Roza Yunita, SP, MSi.

**IT Division** : Bastian Nova, S.Si, M.Biotek  
Robi Trivano

**Master of Ceremony  
(Opening/Closing)** : Liza Aulia Yusfi, S.Si  
Aisyah Salsabilla

**Moderator Keynote Speaker** : Prof. Dr. Sumaryati Syukur, M.Sc  
Assoc. Prof. Dr. Aisyah Ellyanti, MD

### Academic Editor/Publication

**Topic: Agriculture and Food  
Technology** : Rahmi Hidayati, SP  
Dedy Saputra Lubis  
Dr. Eng. Muhammad Makky, S. TP., M. Si  
Prof. drh. Hj. Endang Purwati R., M.S., Ph.D

**Topic: Bio-based Enzyme and  
Material** : Maythesya Oktavioni, SP  
Prof. Dr. Sumaryati Syukur, M.Sc  
Dr. rer. nat. Syafrizayanti, S.Si, M.Si

**Topic: Bio-based Drugs and  
Medicine**

: Desi Cania  
Fauziah Rizki Mareta Bagus, SP  
dr. Hirowati Ali, PhD  
Lili Fitriani, S.Si, M.Pharm.Sc., Apt

**Topic: Bioengineering and  
Bioremediation**

: Liza Aulia Yusfi, S.Si  
Dr. Djong Hon Tjong, S.Si, M.Si, M.Si

**Topic: Natural Resources and  
Conservation**

: Tika Runifah, SP  
Fadhil Darmawan  
Prof. Ir. Yonariza, M.Sc, Ph.D

**Moderator Parallel Session**

**Topic: Agriculture and Food  
Technology**

: Dr. P.K. Dewi Hayati, SP, M.Si  
Dr. My. Syahrawati, SP, M.Si  
Roza Yunita, SP, M.Si

**Topic: Bio-based Enzyme and  
Material**

: Fransiska Angelina Rezekinta

**Topic: Bio-based Drugs and  
Medicine**

: Fauziah Rizki Mareta Bagus

**Topic: Bioengineering and  
Bioremediation**

: Zetriya Andini

**Topic: Natural Resources and  
Conservation**

: Yusmarni, SP, M.Sc

---

## Rundown of Event

### International Conference on Bio-based Economy for Application and Utilization

Date : Wednesday, 16<sup>th</sup> December 2020  
 Via : Zoom Meeting  
 ID : 842 5470 7508  
 Passcode : ICBEAU

Time	Schedule	Person in charge
07.45–08.00	Log in zoom	IT/LPPM
08.00–08.02	Opening Ceremony	MC
08.02–08.05	Singing National Anthem “Indonesia Raya”	Recorded Song/IT/LPPM
08.05–08.10	Opening Video of ICBEAU 2020	IT Team
08.10–08.20	Opening Speech from Chief of Committee	Prof. Dr.sc.agr. Ir. Jamsari, MP.
08.20–08.30	Opening Speech from Head of LPPM Andalas University	Dr.-Ing. Ir. Uyung Gatot Syafrawi Dinata, M.T.
08.30–08.45	Wonderful of West Sumatera	IT Team
	Keynote speech (1 <sup>st</sup> Panel Discussion)	
08.45–09.45	<b>1. Assoc. Prof. Dr. Pasupuleti Visweswara Rao</b> (Bio-based Drugs and Medicines for Metabolic Disease) <b>2. dr. Rauza Sukma Rita, Ph.D</b> (Antidiabetic Potential of Catechin Gambir ( <i>Uncaria gambir</i> Roxb))	Assoc. Prof. Dr. Aisyah Ellyanti, MD
	<i>Appreciation and Photo Session</i>	



09.45–10.00	Introduction of Unand	IT/LPPM/Int. Office
10.00–11.30	<p>Keynote speech (2<sup>nd</sup> Panel Discussion)</p> <p><b>1. Asst. Prof. Saowakon Wattanachant, Ph.D</b> (Application of Retort in Meat Product Processing)</p> <p><b>2. Prof. Dr. Inez H. Slamet Loedin</b> (New Rice Breeding Technology : The CRISPR Gene Editing Researches at IRRI)</p> <p><b>3. Dr. Rosewine Joy</b> (Sustainable Transition, Transformation and Disruption in Agro-Ecological Systems)</p>	Prof. Dr. Sumaryati Syukur, M.Sc
	<i><b>Appreciation and Photo Session</b></i>	
11.30–11.45	Direction to join seminar room	IT/LPPM
11.45–13.00	Break	Committee
13.00–13.30	Log in	IT/LPPM
	Paralel Session	
13.30–15.40	<p><b>Room I</b> (Agriculture and Food Technology)</p> <p><b>Room II</b> (Bio-based Enzyme and Material)</p> <p><b>Room III</b> (Bio-based Drugs and Medicine)</p> <p><b>Room IV</b> (Bioengineering and Bioremediation)</p> <p><b>Room V</b> (Natural Resources and Conservation)</p>	IT/Room Coordinator/LPPM
15.40–16.00	Break	Committee
16.00–17.00	<p>Closing Ceremony</p> <ol style="list-style-type: none"> <li>Best Presenter Announcements</li> <li>Closing Speech for Chairman of ICBEAU Committee</li> </ol>	Head of LPPM/Committee

# Table of contents

Welcome address by Head of LPPM	ii
Welcoming Speech of The Committee's Chairman	iv
Committee Structure	vi
Rundown Event	viii
Table of Content	x
Topic Classification	1
Keynote Speaker Abstract	17
Oral Presenter Abstract	21

## Conservation

TOPIC CODE : C-2  
TIME : 13:30 -15:20  
MODERATOR : Adrinal

ID	NAME	TITLE
12	O Emalinda, J Juniarti , I Darfis, Y Ramayani, D D Putri	Study of Chemical and Biological Properties on Paddy Field at Nagari Taram, Harau District, Limapuluh Kota Regency
43	Z Naspendra, A Aprisal, NI Hijri, M Harianti, J Junaid	Digital Mapping and Soil Carbon Stock Distribution on Various Landuse of Tropical Peatland in Pesisir Selatan, Sumatra Barat
47	A Maulana, S Prima, D Rezki, V Sukma, A Fitriani, H Herviyanti	Carbon Sequestration from Bamboo Biochar on The Productivity of Ultisols and Soybean ( <i>Glycine max</i> L.) Plants
48	T B Prasetyo, Z Naspendra, A Maulana, M Solfianti, S D Krisna, and H Herviyanti	Potential of Biochar Bamboo and Sub-Bituminous Coal as Amendment of Acid Mineral Soils for Improving the Plant Growth of Arabica Coffee ( <i>Coffea Arabica</i> L.)
53	M Harianti, J Junaidi, O Emalinda, H Herviyanti, and A Azizah	The Physicochemical Properties of Monoculture Land In Several Slopes at Northern Areas of Mount Talang
57	A Adrinal, G Gusmini, I Darfis, and E L Putri	Performance of Some Soil Physical Properties of Arabica Coffee Plantation in Solok Regency
59	H Hermansah, N Sandi, Z Naspendra	Increasing of Land Quality of Former Alluvial Gold Mine with Rice Husk Biochar in The Regency of Sijunjung
67	G Gusmini, Y Yaherwandi, A Adrinal, R Panji, E LPutri	Escalation of Nutrient Status in Ex-Gold Mining Land with the Application of Rice Terra Preta Biochar Technology (Tetadi)


70	H Herviyanti, A Maulana, T B Prasetyo, I Darfis, and L Hakim	Activation of Sub-bituminous Coal with Dolomite to Improve Ultisols Chemical Properties and Growth of Palm Oil ( <i>Elaeis guineensis</i> Jacq.)
100	G Gusmini, A Adrinal, R Panji, S E Bella, E L Putri	Potential of Rice Biochar and Cage Fertilizer as Phythoremediation Agents of Gold Mine Used Soil and The Growth of Sunflower
114	S Ramadhan, H Hermansah, B Rusman, S Yasin	Erosion Hazard Index (EHI) on Forest Land Use, Land Clearing, and Oil Palm Plantation in Sub-Watershed Kaos – Jambi

PAPER • OPEN ACCESS

## The improvement of paddy soil chemical properties following the application of rice husk derived biochar in the Regency of Sijunjung

To cite this article: Hermansah *et al* 2021 *IOP Conf. Ser.: Earth Environ. Sci.* **741** 012029


View the [article online](#) for updates and enhancements.



**The Electrochemical Society**  
Advancing solid state & electrochemical science & technology  
2021 Virtual Education

**Fundamentals of Electrochemistry:**  
Basic Theory and Kinetic Methods  
Instructed by: **Dr. James Noël**  
Sun, Sept 19 & Mon, Sept 20 at 12h–15h ET

Register early and save!



# The improvement of paddy soil chemical properties following the application of rice husk derived biochar in the Regency of Sijunjung

Hermansah<sup>1</sup>, NSandi<sup>1</sup>, and Z Naspendra<sup>1\*</sup>

<sup>1</sup>Department of Soil, Faculty of Agriculture, Andalas University. Jl. Kampus Unand Limau Manis, Padang–25163

Email: nofritasandi85@gmail.com

**Abstract.** The district of Dharmasraya, Sijunjung and Pasaman Barat are the three main locations of illegal gold mining in West Sumatra. This kind of activity triggers a lot of land-use changes and the loss of agricultural land within those areas and creates environmental problems as well. Decreasing agricultural land will bring a significant impact on food availability within the region. To protect the scarcity of food, we conducted remediation of ex-gold mining land on those three locations by using biochar made from rice husk. This study was carried on at Batu Manjular village, Kupitan sub-district in Sijunjung for four months, where soil sample was analyzed at Soil Science Department, Faculty of Agriculture, Andalas University. The experiment use 6 level of biochar application, run from A [without biochar]; B [fulfil of 2% soil organic matter content [SOM]]; C [fulfil 3% SOM]; D [fulfil 4% SOM], E [fulfil 5% SOM] and F [fulfil 6% SOM] with three replication. The result shows the application of rice husk-derived biochar increased soil quality including the chemical properties of the soil and improving nutrient retention and land productivity.

**Keywords:** ex-gold mining land, rice husk biochar, nutrient retention

## 1. Introduction

Gold mining activity in West Sumatera can be found in West Pasaman, North Solok, Dharmasraya, and Sijunjung districts. There are two methods of mining based on the process; primary gold mining is conducted by grilling stones or rocks and then being continued to separating process gold from other minerals, and alluvial gold mining is conducted by sieving excavated minerals because gold is separated as the rock weathered. In Sijunjung, gold mining is an alluvial one and mined illegally so that there is no report concerning this activity, whether the quantity of gold or the large area mined.

Such illegal gold mining is an economically supporting activity done by people to increase family income. Besides giving a positive contribution to the economic sector, however, it also contributes negatively to some environmental sectors such as destroying natural structures, flora, and fauna, decreasing water quality, creating air pollution, the downing of soil water surface, as well as changing environmental esthetics.

Cultivating of ex-mining field needs some methods or certain treatments in the order it can be reused as a productive farming field, called reclamation. Some studies have been conducted concerning with reclamation of ex-mining fields such as planting some soil covering plants, giving guano fertilizer, compost, and others. However, giving rice husk biochar to ex-alluvial gold mining fields has been never conducted, thus, this study needs to be done. Biochar is supposed to be able to



repair the quality of ex-alluvial gold mining fields and able to reduce field reclamation costs. Besides the high availability of raw materials, giving biochar needs only once at the beginning of the reclamation process due to long-lasting in the soil.

## 2. Method

Giving biochar of rice husk to ex-alluvial gold mining area that was used for rice field was conducted for 5 months [Mei – September 2020] in Nagari Batu Manjuler of Sijunjung district and then analysis of some soil chemical criteria was conducted in the laboratory of soil program of Agriculture Faculty of Andalas University. Batu Manjuler is a village located in the Sijunjung district of west Sumatera, 104 km from Padang, the capital of West Sumatera Province. Batu Manjuler is one of the illegal alluvial gold mining spots in Sijunjung by switching productive rice fields to open gold mining areas. [Fig. 1].



Figure. 1. Village of Batu Manjuler seen from Satellite [12 November 2020]

Designs used in this study was completely randomized design with 6 treatment and replicated 3 times of biochar using: a dose of biochar 2 % [19.5 ton/ha], a dose of biochar 3 % [39 ton/ha], a dose of biochar 4 % [58.5 ton/ha], a dose of biochar 5 % [78 ton/ha], dose of biochar 6 % [97.5 ton/ha], and control [without biochar]. Data analysis by analysis of variance using Tabel ANOVA 5%. If F counted more than F table 5%, so test BNJ 5% is conducted.

Field preparation was started from soil cultivation using a hand tractor, after that making research terrace in the large of 2 x 3 meter. Taking soil sample was conducted twice, just after cultivating by using hand tractor and then after giving biochar, after harvesting.

Treatment conducted during the study involved watering, weeding, and fertilizing. Plant growing observation was conducted to see the growth of productive saplings and the height of the plant by giving biochar. After harvesting, the soil sample was taken to be analyzed to know soil chemical properties criteria in the laboratory of soil program of Agriculture Faculty of Andalas University.

### 3. Result and Discussion

#### 3.1 Soil Chemistry Criteria of Ex Gold Mining Land before the application Biochar

The result of laboratory analysis shows that soil chemistry criteria in the land of ex gold mining area are very poor [Table 1].

Table 1. Soil chemical properties of rice field in the land of ex gold mining before giving rice husk biochar

Soil Chemistry	value	Status *]
pH H <sub>2</sub> O	4,35	Very acid
Total N[%]	0,06	Very low
P-available [ ppm ]	0,80	Very low
Organic-C [ % ]	0,07	Very low
Exch K [me/100g]	0,21	Low

\*] Soil Research Center staff [1983 cit Hardjowigeno, 2003]

#### 3.2 Soil Chemical Properties of Ex Gold Mining Land after the application of Rice Husk Biochar

Analysis result of soil chemistry criteria of ex-gold mining land that has been reused as rice field by giving rice husk biochar treatment, conducted in the laboratory, shows the result as described in Table 2.

Soil pH value increases along with biochar application, the more biochar is given to the rice field soil of ex-gold mining land, the more soil pH value increased although it is not significant, it is due to the ability of biochar to increase soil pH. Nurida [2014] reported that biochar application can improve soil chemical properties, among them is to increase pH [H<sub>2</sub>O] and CEC of soil in various sandy soil textures. In drying acid land, the influence of giving biochar is significant to increase soil pH, [Nurida et al. 2012; Nurida et al. 2013; Zhu et al. 2014] however, it did not much influence on non-acidic soil [Nurida et al. 2013].

Besides increasing soil pH, Rice husk biochar application has also contributed to the increasing of Organic Carbon in the soil. Organic Carbon in the soil increases during treatment although it is not much significant for the first period of planting. The result of a study in some areas shows that soil Organic Carbon levels can increase, be constant, or decrease after being given biochar [Nurida, 2014]. Steiner et al. [2007] reported that biochar as a material to repair soil is recalcitrant, more both resistant to oxidation and constant in the soil so that it has a long period of influence on the improvement of soil fertility [Organic Carbon soil and CEC].

The increasing of N and P values in the soil is not derived from biochar given but from inorganic fertilizer given to the rice field as additional nutrients for rice plant. Biochar plays in retaining nutrients to be available for plants. Nisa [2010] states that using biochar in the agriculture sector is due to the relation of nutrients and its high persistency. Nuraida [2014] reported that the increase of N and P unsure varies.

Table 2. Paddy soil chemical properties of ex-gold mining land after rice husk derived biochar application

Treatments	pH	C-Organics [%]	N-Total [%]	P-available [Ppm]	Ca-exch [me/100g]	Mg-exch [me/100g]	K-exch [me/100g]	Na-exch [me/100g]
A [2 % BO]	5,13 <sup>a</sup>	0,37 <sup>vl</sup>	0,11 <sup>l</sup>	7,37 <sup>l</sup>	2,91 <sup>l</sup>	2,26 <sup>m</sup>	0,29 <sup>l</sup>	0,44 <sup>m</sup>
B [3 % BO]	5,43 <sup>a</sup>	0,77 <sup>vl</sup>	0,23 <sup>m</sup>	16,29 <sup>m</sup>	5,58 <sup>l</sup>	0,93 <sup>l</sup>	0,37 <sup>l</sup>	0,38 <sup>l</sup>
C [4 % BO]	5,72 <sup>ma</sup>	0,94 <sup>vl</sup>	0,22 <sup>m</sup>	12,69 <sup>l</sup>	5,14 <sup>l</sup>	0,72 <sup>l</sup>	0,38 <sup>l</sup>	0,38 <sup>l</sup>
D [5 % BO]	5,78 <sup>ma</sup>	1,30 <sup>l</sup>	0,20 <sup>l</sup>	17,30 <sup>m</sup>	5,32 <sup>l</sup>	0,90 <sup>l</sup>	0,40 <sup>m</sup>	0,33 <sup>l</sup>



E [6 % BO]	5,89 <sup>ma</sup>	2,77 <sup>m</sup>	0,47 <sup>m</sup>	27,62 <sup>m</sup>	9,14 <sup>m</sup>	0,08 <sup>vl</sup>	0,62 <sup>m</sup>	0,63 <sup>m</sup>
Control	4,30 <sup>va</sup>	0,10 <sup>vl</sup>	0,08 <sup>vl</sup>	0,81 <sup>vl</sup>	1,63 <sup>vl</sup>	1,68 <sup>m</sup>	0,25 <sup>l</sup>	0,16 <sup>l</sup>

*Criteria: Soil Research Center staff [1983 cit Hardjowigeno, 2003]*

*Notes: m = medium, l = low, vl = very low, a = acid, ma = moderately acid, va = very acid*

Analysis result of Calcium, Magnesium, Potassium, and Natrium of rice field soil of ex-gold mining land treated with rice husk biochar differently shows that there was an increase of nutrient content in every treatment even though it was not significant. This matter goes along with the role of biochar that can increase cation CEC so that factory-made fertilizer given to rice plant can be retained by biochar and be available for the plants. Biochar is alkaline [as synthesized in good condition] and some of them are rich in alkaline components [Ca, Mg, dan K] be able to contribute to acid neutralization and reduce the solubility of poisonous minerals like aluminum in the soil [Gruba dan Mulder 2008].

### 3.3 Rice Plant Growing following the application of Rice Husk Biochar

Observation of rice growth planted in the rice field of ex-alluvial gold mining land was conducted only three times; weeks 5, 9, and 12 after planting.

**Table 3.** Paddy soil chemical properties of ex-gold mining land after rice husk biochar application

Treatment	saplings [tree]			Plant Height [cm]		
	Observation at			Observation at		
	1	2	3	1	2	3
A [ 2 % BO ]	19	20	18	48	63	75
B [ 3 % BO ]	17	23	22	53	58	85
C [ 4 % BO ]	26	28	25	58	72	87
D [ 5 % BO ]	25	31	29	52	69	97
E [ 6 % BO ]	33	41	35	62	74	112
Controlled	8	12	10	51	55	66

Giving rice husk biochar to rice fields of ex gold mining land has a variety in the influences to the growing rice plant. Even though it varies, the difference in the number of rice buds is very significantly different between controlled and treated plants high dose performed on biochar application of agricultural land for the former gold mining. Biochar plays important role in increasing pH value, increasing Organic Carbon, and retaining soil nutrients so given inorganic fertilizer can be available for the plant as its growing nutrients.

## 4. Conclusion

The improvement of paddy soil chemical properties of ex-gold mining area after being given biochar varies based on the dose given, it can be known from soil chemistry criteria changing, such as the increase of soil pH, C-organic unsure, P available, N- total as well as increased alkaline cation unsure. The increase of soil chemistry criteria is also due to the role of rice husk biochar that was given to the soil of ex gold mining land, able to increase soil pH and retent nutrients giving to the soil through inorganic fertilizer so that available for the plants.

## Conflict of Interest

No potential conflict of interest was reported by the authors.

## References

- [1] Gruba, P., J. Mulder. 2008. Relationship between Aluminum in Soils and Soil Water in Mineral Horizons of a Range of Acid Forest Soils. *Soil Science Soc. Amer. J.* 72: 1150-1157.
- [2] Nisa, K., 2010. Pengaruh pemupukan NPK dan biochar terhadap sifat kimia tanah, serapan hara dan hasil tanaman padisawah. Thesis. Banda Aceh: Universitas Syiah Kuala.
- [3] Nurida, N.L., dan A. Rachman. 2012. Alternatif Pemulihan Lahan Kering Masam terdegradasi dengan Formula Pembena Tanah Biochar di Typic Kanhapludults Lampung. *Prosiding Teknologi Pemupukan dan Pemulihan Lahan terdegradasi.*2012. Hal 639-648.
- [4] Nurida., N.L., A. Rachman dan Sutono. 2012. Potensi pembena tanah biochar dalam pemulihan sifat tanah terdegradasi dan peningkatan hasil jagung pada Typic Kanhapludults lampung. *Jurnal Penelitian Ilmu-Ilmu Kelaman: Buana Sains.* Tribhuana Press. Vol 12:No. 1. Hal: 69-74.
- [5] Nurida, N.L., A. Dariah dan A. Rachman. 2013. Peningkatan kualitas tanah dengan pembena tanah biochar limbah pertanian. *Jurnal tanah dan Iklim* 37[2]; 69-78.
- [6] Nurida, N.L. 2014. Potensi Pemanfaatan Biochar untuk Rehabilitasi Lahan Kering di Indonesia. *Jurnal Sumberdaya Lahan Edisi Khusus*, Desember 2014; 57-68.
- [7] Steiner, C. 2007. Soil charcoal amendments maintain soil fertility and establish carbon sink-research and prospects. *Soil Ecology Res Dev.*1-6.