International Conference on Bio-Based Economy and Agricultural Utilization

Research
Collaboration
Commercialization

ABSTRACT BOOK and SEMINAR PROGRAM

RISTEKDIKTI

BKS PTN BARAT

In Collaboration with
Faculty of Agriculture
Andalas University

September, 17-18 2019
Kyriad Bumi Minang
Padang, West Sumatera
Indonesia

committee 2019

ICBEAU

http://icbeau.id/

SCOPE OF TOPIC

Science-technology and innovations:
Agronomy
Animal Production and Nutrition
Biological Based Enzyme
Enviromental Industry
Feed Technology
Food Processing
Microbiology
Natural Resources Management
Pharmacy
Plant Breeding
Plant Protection
Soil Science

Business:
Agribusiness
Global Trade
Market Engineering

Policies:
Government Policy
Intelectual Property Rights
International Trade

Welcome Address by The Rector of Andalas University

Assalamu'alaikum Wr. Wb. And Good morning to all of you.
Respected The Chairman of BKS-PTN Wilayah Barat
Respected the Chairman and all Dean involved in the BKS-PTN in Agriculture Wilayah Barat
Dear respected keynote speakers
Members of the organizing committee
Dear participants and observers
Distinguished guests, respected colleagues, ladies, and gentlemen

As the Rector of Andalas University, let me thank your present here in this International Conference on Bio-Based Economy and Agricultural Utilization (ICBEAU-2019). On my view of point, this seminar has a very strategic position in responding the global development, especially in agricultural sectors. 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-2019 seminar, with sub-theme: Research, Collaboration, and Commercialization should have a very significant impact on the above-mentioned issues.

Ladies and Gentlemen

As the rector of Andalas University, I personally very support to this event. This is in time manner also has a deepen meaning particularly, since Andalas University has just celebrated its 63rd anniversary, while Faculty of Agriculture will celebrate its 65th anniversary. For that reason, we thanks to all parties supporting and contributing to implementing this International Conference.

I am believing and very sure, that this seminar will bring a new horizon on the agricultural view of point. Especially for the agricultural faculties focusing so far on the food production aspect, will shift to the new paradigm "beyond the food". Accelerated and supported by digital technology advances, the agricultural 4.0 should come with more diverse and more ready to commercialized bio-based materials.

Finally, let me say many thanks to all parties contributing to the success of this seminar. Especially I would like to thank all keynote speakers:

- Morio Tsukada Ph.D. from Mie University, Japan
- Prof. Dr. Asmah Awal from University Technology MARA- Malaysia
- Dr. Duong Van Nha from Kien Giang University-Vietnam, and
- Prof. Ir. Dian Fiantis, MSc. Ph.D. as soil scientist from Andalas University,

And who kindly join this seminar and share their experience and expertise in this conference.
Moreover, we also thank all parties involved in this ICBEAU-2019, especially the chairman of West BKS-PTN for supporting this event and also to the all Deans member of West BKS-PTN in Agriculture and all participants involving to this seminar.

Congratulation, also finally I would like to express to the organizing committee for their tremendous efforts in organizing the conference.

By this, I open this seminar officia

Rector of Andalas University,

Prof. Dr. M. Tafdil Husni

Welcome Address by The Chairman of BKS-PTN in Agricultural West Part and as Dean of Agricultural Faculty of Andalas University

Assalamu'alaikumWr. Wb.
Good morning to all of you.
Respected Rector of UniversitasAndalas
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 and Agricultural Utilization (ICBEAU-2019) that will be held today. This conference is carried out based on our last agreement in promoting the capacity building human resources involved in our BKS-PTN in Agriculture in a Western part zone. Moreover, this is also strategic in the context of the 65th lustrum anniversary of the Faculty of Agriculture of Andalas University. This conference is expected to strengthen scientific interaction and collaboration and more broadening of agricultural utilization viewpoint among the scientists and experts from the agricultural faculties involved in the BKS PTN in agriculture in Western Part Zone.

Respected Ladies and Gentlemen

Many things are going on all sides of the world today. The deficiencies, scarcity, and environmental concerns that are produced by fossil-based materials currently have a major impact on the quality of human life and environmental sustainability. This conference at least sends a message that agricultural related activities must play a role more than just producing food in the future.

We, at faculty of agriculture, also supported by policy at the university level, continuously encourage faculty members, including our students, both first

graduated & post-graduate program, to actively take a role in the development of agricultural research and present their work directly. One kind of support is by increasing research funding every year and giving support to them to attend a suitable event as like as this 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.

- Morio Tsukada Ph.D. from Mie University, Japan
- Prof. Dr. AsmahAwal from University Teknologi MARA- Malaysia
- Dr. Duong Van Nha from Kien Giang University
- Prof. Ir. Dian Fiantis, MSc. Ph.D.

We also thank all parties involved in this ICBEAU-2019, especially the chairman of BKS-PTN Wilayah Barat for supporting this event and also to the all member of BKS-PTN in Agriculture Wilayah Barat and all registered participants either oral and poster presenter.

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

Success for all of us,

Chairman of the BKS-PTN in
Agriculture of Western Part,

Dr. Ir. Munzir Busniah, M.Si

Welcoming Speech of The Committee's Chairman

Dear all,

On behalf of the committee, let me welcome you and say many thanks for participating in this International Conference on Bio-Based Economy and Agricultural Utilization (ICBEAU-2019).

This conference is held in responding to our needs to revitalize and reposition the agricultural sectors in the future. The perspective of agricultural sectors currently is limited to the food paradigm, which is considered to be underutilized. Human needs currently are not limited to the stomach problem that has to be fulfilled but also dealt with many aspects where the agricultural product plays more significant roles. Drug development, bio-based energy development, phytoremediation and better nutritional quality of the food are some aspects that have to be addressed in this respect. Many educational institutions of agricultural currently are focusing only to the food sectors as our conserved and eternal main paradigm. I would like to say, that this view of point has to be changed! We have to shift our mindset that activities in the agricultural sector should be broadened to be more extensive and more diverse, serving in various aspects of human's life. In this manner, this conference should fulfill its mission.

Another concern that to be addressed for us as an academician, is "the capacity building of human resources". This keyword is facing its challenge, especially in 4.0 digital era, where global communication and interconnection are something that could not be rejected and it has to be accepted as "it is". Fact, that the competencies of human resources and academicians in many educational institutions of agriculture are needed to be upgraded and better trained is a reality. Thus, in this view of point, we all universities and faculties involved in the part western of BKS PTN in agriculture should find our necessity in this forum.

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; Morio Tsukada Ph.D. from Mie University, Japan, Prof. Dr. Asmah Awal from University Teknologi MARA-Malaysia, Dr. Duong Van Nha from Kien Giang University-Vietnam, and of course our soil scientist Prof. Ir. Dian Fiantis, MSc. Ph.D. from agricultural faculty Andalas University-for their collaboration and their kindness to share their experience and their expertise in this forum. Many, many thanks also addressed to the Chairman of Cooperation Agency for State Universities in the Western Region (BKS-PTN Wilayah Barat), and Cooperation Agency for State Universities of Agricultural in the Western Region, Rector of Andalas University, all sponsors including PT Indolab, PT Merck Indonesia, CV Mutiara, The West Sumatra Tourism Office, and The Institute of Research and Community Service Andalas University 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 of agriculture, capacity building and fulfill our theme: **Research, Collaboration, and Commercialization**.

Regards

Chairman of the Committee

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

Committee Structure

Internationa Conference on Bio-Based Economy and Agricultural Utilization – ICBEAU 2019

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- Rector of Andalas University
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- Dean of Agricultural Faculty-Andalas University
- Dr. Indra Dwipa, MS.

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Ryan Budi Setiawan, SP. MSi

Food Processing and Food Technology :

Dr. Alfi Asben
Tuty Anggraini, PhD.

Plant Protection and Microbiology :

Dr. My Syahrawati,SP,M.Si
Dr. Yulmira Yanti
Prof. Yetti Marlida

Soil Science :

Dr. Gusmini
Dr. Mimien Harianti,SP,MP

Agribusiness, Enviromental Industry, Natural Resources Management:

Dr. Hasnah
Dr. Zednita Azriani

Green Biotechnology and Biological Based Enzyme:

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Elma Nita Gozalia, SP.
Muhammad Fadli SP. M.Biotek.

Animal Production and Nutrition and Feed Technology:

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Moderators:
Dr. Ir. Irawati Chaniago, M.Rur.Sc

Rundown of Event

International Conference on Bio – Based Economy and Agricultural Utilization

Date : Tuesday, 17th September 2019
Place : Kriyad Hotel

Time	Schedule	Person in charge
08.00–08.30	**Registrasi**	Secretariat
	Opening Ceremony	
08.30–08.35	Opening by MC	Muhammad Fichri, SP and Liza Aulia Yusfi, SSi
08.35–08.50	Pasambahan Dance	Dance Team of Departement Agriculture
08.50–09.30	Speech by : 1. Chairman of BKS-PTN in Agricultural West Part 2. Chairman of BKS-PTN West Part 3. Rector of Andalas University	 Dr. Ir. Munzir Busniah, Msi Prof. Tafdil Husni, SE, MBA, Ph.D
09.30–09.40	Coffee Break	
09.40–12.00	***KEYNOTE SPEECH*** **Moderator:** Dr. Irawati, M.Rur.Sc	**Morio Tsukada Ph.D.** (Insect Ecology, Faculty of Bio-resources, Mie University Japan) **Prof. Dr. Asmah Awal** (Dean of UiTM-University Tecnology MARA-Malaysia) **Dr. Duong Van Nha** (Dean Faculty of Agriculture and Rural Development The Kien Giang University) **Prof. Dr. Dian Fiantis, MSc.** (Soil Scientist-Faculty of Agriculture Andalas University)
12.00–12.10	Photo Session	Rahmi Hidayati, SP

12.10–13.30	Lunch-Rest Session	
13.30–14.30	Poster Session	Afrianingsih Putri, SP, MSi and Cindy Paloma, SP, MSi
13.30–17.00	**Paralel Session**	
	1. Topic I	Prof. Dr. Ir. Yetti Marlida, MS
	2. Topic II	Dr. My Syahrawati, SP, MSi
	3. Topic III	Dr. P.K. Dewi Hayati, SP, Msi
	4. Topic IV	Dr. Gusmini, SP, MP
	5. Topic V	Yuerlita, SSi, MSi, PhD
17.00–18.30	Rest-Preparation for Closing Ceremony and Dinner	Event Division
18.30–19.30	Dinner	Event Division
19.30–21.00	**Closing Ceremony**	
	Opening by MC	Muhammad Fichri, SP and Liza Aulia Yusfi, SSi
	Closing Speech	Dr. Ir. Munzir Busniah, Msi
	Best Presenter and Best Poster Announcement	Dr. P.K. Dewi Hayati, SP, Msi
	Closing by MC	Muhammad Fichri, SP and Liza Aulia Yusfi, SSi

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Topic D : Soil Science, Land Use Management, and Plant Culture Medium
Moderator : Dr. Gusmini, SP, MP

No	Name	Afilliation	Title
Session 1 : 13.30 – 14.30			
1	Suwardi	IPB University	Capability of Natural Zeolite to Reduce Fe and Mn Concentration in Acid Mine Drainage
2	Yulnafatmawita	Andalas University	Effect of Crop Age on Organic Carbon Sequestration at Tea (*Camelia Sinensis*) Plantation Under Wet Tropical Area
3	Yusra	Malikussaleh University	Soil Chemical Characteristics on The Diversity of Slope Positions in The Smallholder A *Pipper nigrum* L., in Lhokseumawe City, Aceh Province
4	Maulana Insanul Kamil	Andalas University	Abundance and Diversity of Soil Macrofauna in Agricultural Intensification Area of Mount Marapi, West Sumatra
5	Elesta Banamtuan	IPB University	Application of Solid and Liquid Organic Matter to Increase P Availability in The Soil
Session 2 : 14.30 – 15.30			
6	Ahmad Riduan	Jambi University	Palm Oil Fuel Ash (POFA) : Innovative Potential Applications as Materials for Heavy Metal Removal in Gold Mining Wastewater
7	Dewi Jayagna	Andalas University	Potential Use of Volcanic Deposits for Geopolymer Materials
8	Syahru Ramadhan	Andalas University	Assessment of Soil Chemical Quality on Landuse of Forest and Oil Palm in Kaos Sub-Watershed

9	Nurmayulis	Sultan Ageng Tirtayasa University	Effect of Biofertilizer Formulation with Addition of Consortium of Microbes and Biosurfactant Dietanolamida Palm Olein to Growth of Cacao Seedling (*Theobroma cacao*).
10	Renfiyeni	University Of Mahaputra Muhammad Yamin	Growth and Yield of Strawberry (*Fragaria Sp.*) in Mixed and Volume Of Plant Media
Session 3 : 16.00 – 16.30			
11	Tran Phuoc Qui	Andalas University	Compare The Growth and Productivity of I.Aquatica Species on Hydroponic Subsystems Within an Aquaponic System
12	Ryan Budi Setiawan	Andalas University	Embryogenic Callus Induction of Coffee (*Coffea Arabica* L.) on Several Plant Growth Regulator Concentration and Incubation Temperature
13	Agustian	Andalas University	Soil Chemical And Biological Properties In Long Term Maize-Based Farming Systems In Mungka Sub-District

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Gresik, 16 Agustus 2022

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Perihal : **Klarifikasi**

Kepada Yth.
Kepala LLDIKTI Wilayah VII
Di Tempat

Dengan hormat,
Sehubungan dengan pengajuan Jabatan Akademik Dosen (JAKAD) Universitas Internasional Semen Indonesia pada dosen berikut :

Nama	: Ufafa Anggarini, S.Si., M.Si.
NIDN	: 0719038901
Program Studi	: Teknik Kimia
Jabatan yang diajukan	: Lektor 300

Maka dengan ini kami sampaikan bahwa pengajuan JAKAD dosen tersebut terdapat catatan revisi bahwa sertifikat atas nama dosen tersebut di atas pada karya ilmiah berupa prosiding diminta untuk disertakan. Akan tetapi, dosen tersebut tidak mendapat sertifikat disebabkan bukan sebagai penulis pertama ataupun sebagai presenter pada judul karya ilmiah berikut :

1. Optimization of non-autoclaved aerated concrete using phosphogypsum of industrial waste based on the taguchi method
2. The potential use of volcanic deposits for geopolymer materials
3. The Effect of Activated Carbon Addition on Woody Cutting Waste Briquette Combustion Quality

Sehingga sertifikat tidak dapat dilampirkan pada karya ilmiah tersebut di atas. Oleh karena hal tersebut, mohon agar diproses pengajuan JAKAD dosen tersebut dari Asisten Ahli ke Lektor.

Demikian surat permohonan ini dibuat untuk digunakan sebagaimana mestinya. Atas perhatian dan kerjasama yang diberikan, kami sampaikan terima kasih.

Hormat kami,
Universitas Internasional Semen Indonesia

Prof. Dr. Ing. Herman Sasongko
Rektor

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KEYNOTE SPEAKERS ABSRACT

Climate Change and Sea Level Rise The Case of Mekong Delta Vietnam

Dr. Duong Van Nha

Kien Giang University of Vietnam

Abstract

Climate and climate change are defined as changes in the climate situation on earth according to natural law. However, climate change is quite rapidly due to human influence, population growth, activities due to living needs, production development of factories, agricultural production, timber extraction, demand for energy resource exploitation, urban development, researching chemical weapons and bomb daily in war. The melting of ice blocks into the water at the two ends of the earth, its consequence is to change the temperature, humidity, and rainfall across the globe. The interference between the maximum sea level and the maximum rainfall makes the coastal areas flooded quickly rise. With the maximum rainfall concentrated in many days, the low-lying areas near the hills and mountains were quickly flooded, human beings cannot promptly cope with natural disasters of human damage and material possessions. Its consequences are warming earth and rising sea level with minimum and maximum amplitude from 3 to 5m high. The frequency of this amplitude is quite thick, the maximum rainfall is concentrated in many days, the maximum temperature in the areas near the equator for a long time, so developments in flood, drought, sea-level rise, tsunami, and saline intrusion. The Mekong Delta is a coastal area, which is the lowest alluvial area, so it is the most sensitive and the most vulnerable area to climate change and sea-level rise. This report is a collection of knowledge and experience on climate change and sea-level rise, in this vulnerable area in the last period. The report included (1). Climate Change Science Overview (2). Climate change in the Mekong Delta, Vietnam, (3). Adaptation to Climate Change in the Mekong Delta.

Keywords : Climate change, sea level rise, Mekong delta Vietnam

Digital Agriculture: Supporting Agriculture Sustainability

Prof. Dr. Dian Fiantis, M.Sc

Abstract

Digital agriculture is an application of the "digital earth" concept proposed in the 1990s and is an expansion of the concept of "precision farming" which emphasizes on agricultural production procedures. The use of digital technologies in agriculture industry can integrate agricultural production from farmland to consumers. These technologies have tools and information to improve productivity and strategic decisions. This paper describes the role of soil science in fulfilling the 4th Revolution in Agriculture for next centuries. The digital soil information, rapid sensing of soil characteristics and online monitoring of agriculture tasks in the field will be discussed. Soil is key and vital point to start digital agriculture. As such, the spatial distribution of soil characteristics is needed in the form of Digital Soil Mapping (DSM). Soil scientists have to use and adopt the latest technology tools to assist in the mapping process. DSM is also known as a cost-effective method to create and use by many involving parties or stake holders. Establishing DSM will provide fast and vast soil information to support soil functions for crop production. DSM involves collection of field samples using representative sampling methods, development of spatial prediction functions and mapping of soil properties. The DSM can quantify spatial variation of key soil properties at various depths and it can be integrated with other data such as climate, vegetation, crop production and protection which are essential to development of digital agriculture. This presentation will illustrate the role of soil information in developing digital agriculture in volcanic and peat regions in West Sumatra, Indonesia at early stage. Volcanic regions in the vicinity of Maninjau, Talang, Marapi, Tandikek, Singgalang, Talamau and Kerinci are being studied and digitally mapped. We have been conducting and surveying the peat regions in West Sumatra since 2017 and create DSM. The use of satellite imagery help us to identify and digitally map the paddy fields in four sub-districts of Solok Selatan and Pesisir Selatan. The tabular data of each paddy field owner or cultivator and other information were collected and integrated with respected vector data (polygon) of paddy fields. We will demonstrate how to monitor soil moisture content by using Internet of Things, the use of X-rays and Infra-Red sensors for soil analysis.

ABSTRACTS of ORAL PRESENTERS

Biotechnology and Biological Based Enzyme

Potential Use of Volcanic Deposits For Geopolymer Materials

Dian Fiantis[1], Dewi Jayagma Ilham[1], Firsta Rexly Kautsar[1], Ufafa Anggarini[2]

[1]Department of Soil Science, Faculty of Agriculture, Andalas University, Kampus Limau Manis, Padang 25163, Indonesia
[2]Department of Chemical Engineering, Univertsitas Internasional Semen Indonesia, Gersik, Jawa Timur, Indonesia

Abstract

Volcanic deposits are abundant in the vicinity of an active and inactive volcano. They are formed from the cooling of magma during explosive volcanic eruptions. They have varying physical properties and can range in size from sub-millimetric ash up to boulder size. As Indonesia is considered as an active volcanic region, volcanic materials are abundant but they are still unexploited to full capacity such as geopolymer raw material. Geopolymers are generally understood as alkali-activated aluminosilicates. They may be considered as an inorganic two-component system which consists of: (1) a reactive solid source of SiO2 and Al2O3, and (2) an alkaline activation solution. The research aims to identify the chemical and mineralogical properties of Mt. Merapi and Mt. Sinabung volcanic ashes as the raw material of geopolymers. Results show that Mt. Merapi consist of amorphous volcanic glass and crystalline (feldspar) minerals with 61.13% SiO2; 17.78% Al2O3; 3.47% Fe2O3; 6.22% CaO. Mt. Sinabung deposit contains amorphous volcanic glass also and crystalline (feldspar) minerals with an oxide content of 49.33% SiO2; 15.93% Al2O3; 6.48% Fe2O3; 5.87% CaO. The high content of silica and alumina in this material showed that it was pozzolan material which can be synthesized to geopolymers. The molar ratio of SiO2/Al2O3 was high, Merapi is 5.84 and Sinabung is 5.26.

Keyword : Tephra, Merapi, Sinabung, Pozzolan, Ration SiO_2/Al_2O_3.

The potential use of volcanic deposits for geopolymer materials

The potential use of volcanic deposits for geopolymer materials

D J Ilham[1], F R Kautsar[1], J Januarti[1], U Anggarini[2], and D Fiantis[1*]

[1]Department of Soil Science, Faculty of Agriculture, Andalas University, Limau Manis, Padang, Indonesia
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Abstract. Volcanic deposits are abundant in the vicinity of an active and inactive volcano. They are produced from the cooling of magma during explosive volcanic eruptions. They have varying physical properties and can range in size from sub-millimetric ash up to boulder size. As Indonesia is considered as an active volcanic region, volcanic materials are abundant but they are still unexploited to full capacity such as geopolymer raw material. Geopolymers are generally understood as alkali-activated aluminosilicates. They may be considered as an inorganic two-component system which consists of: [1] a reactive solid source of SiO_2 and Al_2O_3, and [2] an alkaline activation solution. The aim of the research is to identify the chemical and mineralogical properties of Merapi and Mt. Sinabung volcanic ashes as the raw material of geopolymers. Results showed that Mt. Merapi contained amorphous volcanic glass and crystalline [feldspar] minerals with 61.13% SiO_2; 17.78% Al_2O_3; 3.47% Fe_2O_3; 6.22% CaO. Mount Sinabung deposit contains amorphous volcanic glass also and crystalline [feldspar] minerals with an oxide content of 49.33% SiO_2; 15.93% Al_2O_3; 6.48% Fe_2O_3; 5.87% CaO. The high content of silica and alumina in this material showed that it was pozzolan material which can be synthesized to geopolymers. The molar ratio of SiO_2/Al_2O_3 was high, Merapi is 5.84 and Sinabung is 5.26.

1. Introduction

Volcanic deposits are produced from cooling magma during explosive volcanic eruptions [1]. They have varying physical properties and can range in size from sub-millimetric ash up to boulder size [2]. A fine solid material of volcanic deposits that are below 2 mm in diameter is called volcanic ash [3]. It can be found in an active and inactive volcano.

Indonesia has active and inactive volcanoes, more than 30% of the world's active volcanoes are in Indonesia, which is around 129 volcanoes [4]. Meanwhile, many volcanoes in Indonesia will result in a higher eruption which produces abundant volcanic deposits. The volume of volcanic deposits in 2010 eruption of Mount Merapi has estimated 1.5 x 10^8 m^3 with the thickness of tephra layer was from 2.5 cm to 10 cm [5], while a volcanic deposit of Mount Sinabung was approximately 3 x 10^8 m^3 with thickness was <10m to 20 m [6].

The composition of volcanic ash depends upon the chemistry of the source magma [7]. Most volcanic ashes contain the main components of silica and alumina, that it presents pozzolanic activity [8]. The volcanic ash of Mount Merapi contained 61.55% SiO2 and 15.85% Al2O3 [9], while Mount

Sinabung contains 74.3% SiO2; 3.3% Al2O3 [10]. Hence, volcanic ashes are an aluminosilicate natural resource that can economically and environmentally benefit [11].

Nowadays, volcanic ash has been used as a soil ameliorant, cement and concretes, ceramic materials, adsorbent [8, 12-14]. Compared to the abundant amount, but volcanic ashes are still unexploited to full capacity 7, 15, 16]. Due to their pozzolanic nature, volcanic deposits will be easier to be applied and be more attractive for engineering that will produce new materials [17], they can be used in agriculture and non-agriculture. One of the new material from volcanic deposits is geopolymer [15, 18, 19, 20]. Geopolymers are a new class of three-dimensional inorganic polymer obtained by reaction of an aluminosilicate material with an alkaline solution [21]. The synthesis of geopolymers requires two components, namely a reactive solid source of aluminosilicates and alkaline solution [22]. The reactivity of volcanic ashes as a raw geopolymer material is affected by the chemical and mineralogical composition, the particle size distribution and the amount of the amorphous phase [11]. Geopolymers will be reactive if they consist of amorphous or non-crystalline minerals. Non-crystalline minerals in volcanic ash are volcanic glass and are found in quite high amounts to reach 25% in Mount Talang volcanic ash [23], and 60% are found in Mount Merapi volcanic ash [9]. Volcanic ashes as a raw material for geopolymers have drawn more attention in the past decades since it does not require high temperatures in processing compared to other sources of aluminosilicate[15]. This research aimed to identify the chemical and mineralogical properties of Mt. Merapi and Mt. Sinabung volcanic ashes as the raw material of geopolymers.

2. Materials and methods

2.1. Study area

The samples of volcanic ash were collected from Mt. Merapi and Mt. Sinabung. Mount Sinabung volcano is located in Karo District, North Sumatera Province, Indonesia [Figure 1], geographically on 3° 10’ 16.7” N and 98° 23’ 24.66” E, the summit is approximately 2,460 m above sea level [asl]. It is a stratovolcano that has been estimated for 400 years inactive, therefore it is categorized as B type of volcano [24]. It turned into type A when it erupted on August 27, 2010, with the type of eruption classified as phreatic [25], and it has been in continuous eruption in 2013, 2015, 2016, 2018.

Mount Merapi is at Central Java [7° 32,5’ S and 110° 26,5’ E] about 30 km north of Yogyakarta city, Indonesia [Figure 1], having a height of 2986 m above the sea level. Geologically, Merapi is a basaltic-andesite volcano formed due to subduction between the Australian oceanic plate and the Eurasian continental plate [26]. The volcano is a large Quaternary stratovolcano composed of volcanic materials deposits such as pyroclastic flow, lava, basaltic andesite tephra [27]. The volume of pyroclastic material in the 2010 eruption of Mt Merapi was estimated to be 1.5 x 10^8 m^3 with the thickness was from 2.5 cm to 10 cm [5].

2.2. Volcanic ash sampling

The volcanic ash from Mount Merapi was collected about 8 km west of the volcano when erupted in 2006 and 2010. They widely distributed in the west to the south area of the volcano having a thickness of about 20 cm. While volcanic ash from Mount Sinabung was taken in January 2017. It was derived from the eruption in 2010, 2013, 2014, and 2016. The samples were taken by a scope until a layer of the soil was found. They were air-dried ground and passed through a 2 mm sieve before chemical and mineralogical analyses.

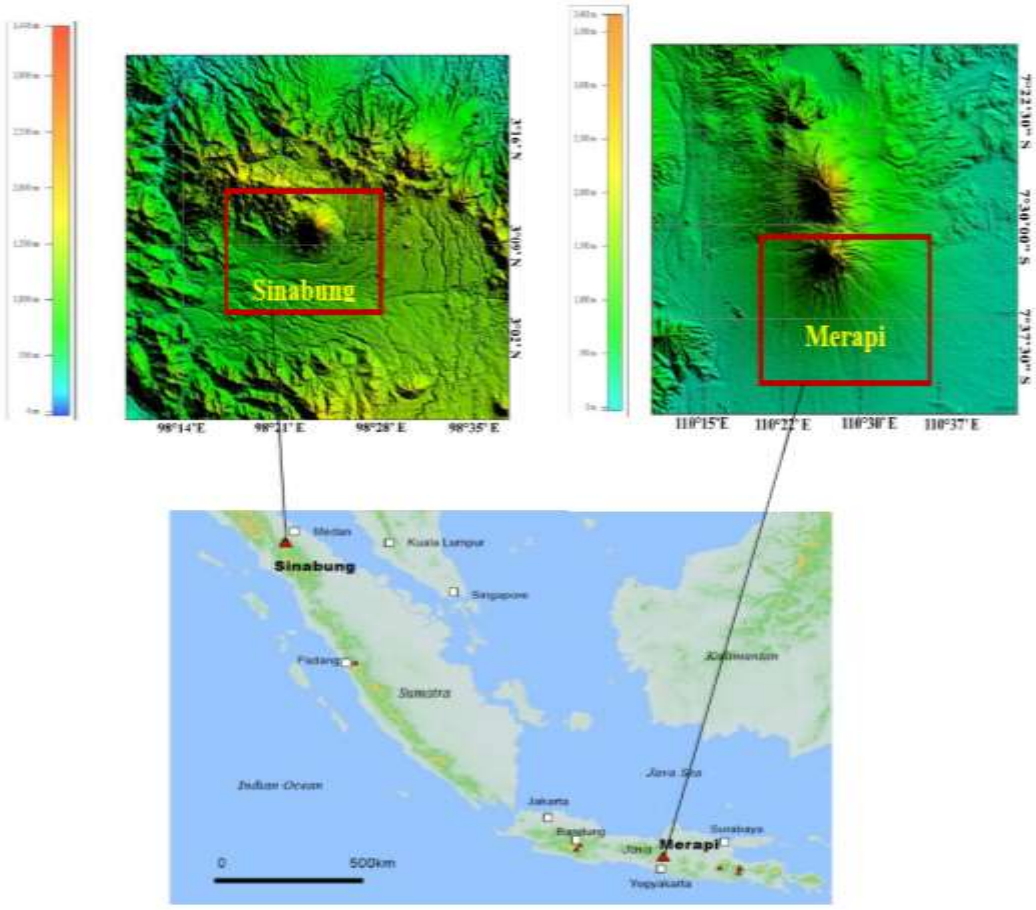

Figure 1. Location of Merapi and Sinabung volcanoes

2.3. Morphology, chemical and mineralogical characteristics analysis of volcanic ash

The color identification is used by the matching method using Munsell Soil Color Chart. The pH of the volcanic ash was determined potential metrically in both deionized water [H_2O] and 1 M potassium chloride [KCl] with a glass electrode in a 1: 2,5 solid/solution mixture. The CEC and exchangeable cations were extracted with 1 M NH_4OAc at pH 7. The phosphor was determined with the Bray II method and extracted with HCl 25%.

The elemental chemical composition of volcanic ash was determined using the X-ray fluorescence spectroscopy [XRF] tool brand PANalytical Epsilon 3. Mineralogical analyses of the volcanic ash were conducted using an X-ray diffractometer [XRD]. The XRD analysis was performed with a PANalytical XPERT-PRO0000000011130968 type. In this apparatus, the Cu Kα [wavelength α1 is 1.54060 and α2 is 1.54443] radiation, operating at 40 kV and 40 mA start angle [˚2θ] = 10,0181 and end angle [˚2θ] = 99.9781, and scanned from 3 to 45◦ 2θ at 1◦/min range. Then, data processing used a High Score Plus software.

3. Results and Discussion

3.1. Morphology and chemical properties of volcanic ash

The morphological and chemical characteristics of the ash from Mount Merapi and Mount Sinabung are summarized in Table 1. Volcanic Ash from Mount Merapi had a different color from Mount Sinabung. The color of the volcanic ash was light gray [10 YR 7/1] for volcanic ash of Mt. Merapi, and gray [2.5 YR 5/1] for volcanic ash of Mt. Sinabung. The gray color of volcanic ash was caused by

rhyolite, decide, and andesite composition that it is a high concentration of non-colored glass and low content of mafic mineral [28]. The color of samples can be used to identify the mineral content of materials. The color of both volcanic samples indicated the presence of colorless minerals, such as feldspar and quartz [29].

Table 1. Chemical properties of the volcanic ash

Parameter	Mt.Merapi	Mt. Sinabung
Color	10 YR 7/1	2.5 YR 5/1
pH KCl	4.78	3.37
pH H_2O	5.12	3.46
P Bray 2 [mg kg^{-1}]	3.53	1.38
P HCl 25% [mg kg^{-1}]	63.10	76.50
CEC [cmol.kg^{-1}]	0.47	0.40
	Exchangeable cations	
Exchangeable K [cmol kg^{-1}]	0.45	0.51
Exchangeable Ca [cmol kg^{-1}]	0.74	0.87
Exchangeable Mg [cmol kg^{-1}]	1.11	1.37
Exchangeable Na[cmol kg^{-1}]	0.31	0.35
Base Saturation [%]	552.96	767.32

Table 1 shows that the accumulated volcanic ash of Mt. Merapi and Sinabung had low pH with acid to very acid criteria. The pH values of the fresh volcanic ash were mostly acidic [5, 23]. The acidity is produced during a volcanic eruption from sulphuric content on volcanic ash surfaces that release protons. It shows in Table 2 that Mt. Merapi had a lower pH than Mt. Sinabung. The CEC of the accumulated volcanic ash of Mt. Merapi and Mt. Sinabung was considered very low [0.47 cmol kg^{-1} and 0.40 cmol kg^{-1}, respectively]. These values had similarities with the CEC of Mt. Talang which had low value at 5.75 cmol kg^{-1} [30]. Exchangeable cation composition was similar for all volcanic ash samples and showed the following distribution trends: Mg > Ca > K > Na. The available volcanic ash phosphate content, extracted by Bray 2, was considered very low. The P available of volcanic ash from Mount Merapi tended to be higher than Sinabung volcanic ash about 155 %. The source of phosphate in volcanic ash was apatite mineral. The dissolution rate of apatite increased with decreasing pH. The potential phosphate, extracted with HCl 25%, was very high. Generally, the potential phosphate of the volcanic ash was considered very high, it was up to 68.02 mg kg^{-1} from Mt. Talang [30].

3.2. Total chemical composition of volcanic ash

Table 2 lists the total chemical composition of all volcanic ash which was determined using the X-ray fluorescence [XRF] analysis. All of the samples primarily consisted of SiO2 and Al2O3 on its framework mineral and lots of elements-bearing minerals, such as Fe, Ca, Mg, K, S, Ca, and P. The composition of volcanic ash depended upon the chemistry of the source magma [7]. All volcanic ash samples were dominated by silica [49.33%-61.13%] which can be considered as andesite to basaltic andesitic [32].

The minerals that possibly present in this material were feldspars [Figure 2], ferromagnesian minerals [usually pyroxene or amphibole] and no quartz [28]. Hence, the volcanic ash was a

moderately gray color. Among volcanic ash samples, the accumulated volcanic ash of Mt.Sinabung contained very high sulfur. The calcium oxide [CaO] found in the three studied ash was greater than the alkaline elements [K_2O and Na_2O]. The greater contents of CaO is believed to be a result of greater plagioclase feldspar [labradorite] content, and the volcanic ash was considered to have basaltic andesitic composition [30].

Total chemical properties of volcanic ash of Merapi and Sinabung showed that the intended *pozzolan* materials which had a high content of SiO_2 and Al_2O_3. The content of SiO_2 and Al_2O_3 in volcanic ash is needed to form Si-O-Al chains in geopolymers. Therefore, the materials are potential for geopolymer syntheses. The ratio of SiO_2/Al_2O_3 molecule in Sinabung volcanic ash was 5.26, while Merapi was 5.84. These values are suitable for geopolymer synthesis, which are considered as basic ingredients and are contained in the intervals of geopolymer synthesis [7].

Table 2. Total chemical composition of volcanic ash

Oxides	Sample [%]	
	Mt. Sinabung	Mt.Merapi
SiO_2	49.33	61.13
Al_2O_3	15.93	17.78
Fe_2O_3	6.48	3.47
CaO	5.87	6.22
MgO	0.79	1.69
K_2O	1.54	2.94
SO_3	17.63	4.99
P_2O_5	1.32	0.80
MnO	0.05	0.10
ZnO	0.03	0.01
Ag_2O	0.18	0.19
TiO_2	0.63	0.43

The optimal value of the ratio SiO_2/ Al_2O_3 for geopolymers varies from 3.3 - 4.5 [32]. Comparison to another raw material geopolymer such as metakaolin and fly ash, volcanic ash materials generally has a higher SiO_2/Al_2O_3 molar ratio. Table 2 shows that volcanic ash of Mount Merapi would be less reactive as a raw of material geopolymer than Mount Sinabung, due to its higher silica content. The higher SiO_2/Al_2O_3 molar ratio in these samples need a high concentration of alkali [33]. Some studies reported that the addition of reactive aluminum can be useful for reactivity of volcanic ash such as calcium aluminum or aluminum hydroxide [34, 35]. Calcium oxide content was reported to affect the process of geopolymer synthesis [20, 35]. The higher CaO make the faster of the hardening time of geopolymer. On the other hand, the greater content CaO in volcanic ash from Mount Merapi than Sinabung may allow lower setting time in the Merapi geopolymers.

3.3. Mineralogical properties of volcanic ash

X-ray diffraction analysis is known based on the reaction of crystalline minerals. The XRD pattern of volcanic ash is illustrated in Figures 2 and 3. The mineralogical composition of volcanic ash of Mount Merapi and Mt. Sinabung had similarities between these samples. The main crystalline mineral content was feldspar. The feldspar is silicates mineral group. Silicates mineral is known as an important group of minerals, almost 40% of the common minerals in an igneous rock are silicates group. Based on the basic structure, feldspar is known as tectosilicates minerals. The previous studies had shown that Mount Merapi mineralogical composition consisted of feldspar, quartz, cristobalite [5], [36].

Feldspar is known that its structures are composed of corner-sharing AlO_4 and SiO_4 tetrahedra. Their framework could accommodate K^+, Na^+, $Ca2^+$ and occasionally large cations. Feldspars were identified by the prominent peaks at 0.318, 0.319, 0.365, 0.376, 0.406, and 0.404 nm, which resulted from microscopic observation.

The diffractogram pattern obtained in X [angle 2 Theta = 2θ] between 15-35° shows that volcanic ash consisted of amorphous mineral structures. Amorphous minerals in volcanic ash were volcanic glass and were found in quite high amounts to reach 25% in Mt. Talang [23], and 60% were in Mt. Merapi [9]. Amorphous minerals in ash greatly affected geopolymer reactivity, high volcanic ash reactivity if there was a higher amorphous mineral content [18]. The Geopolymer synthesis was also influenced by mineral composition [33].

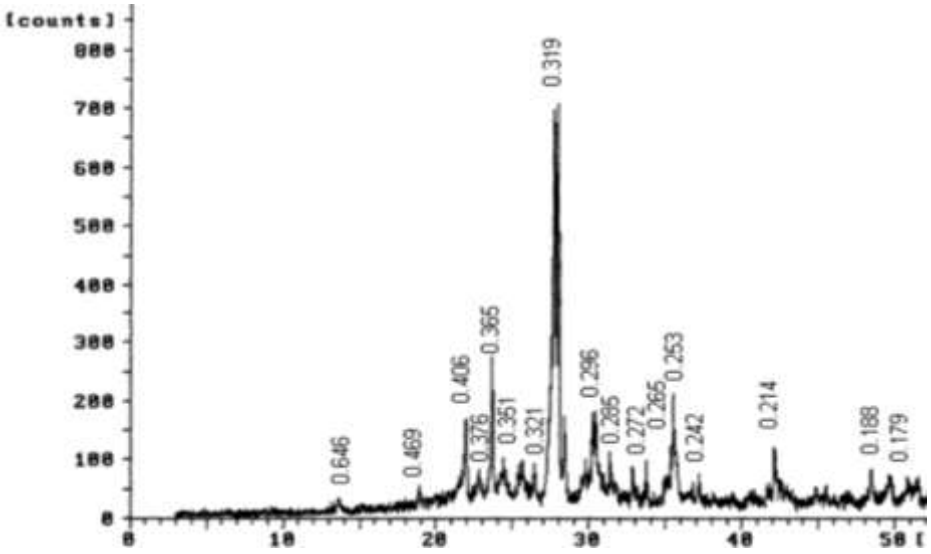

Figure 2. XRD pattern volcanic ash of Mt. Merapi

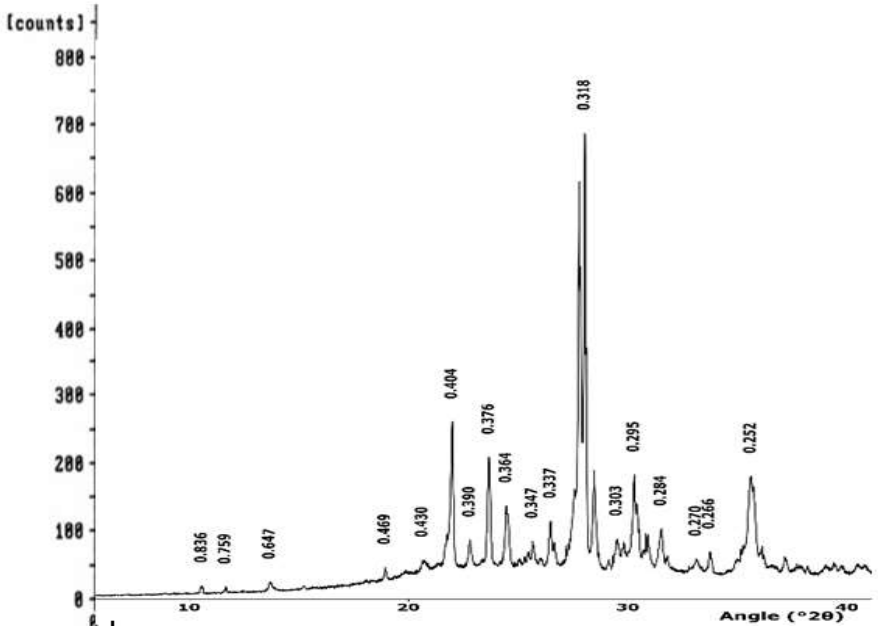

Figure 3. XRD pattern volcanic ash Mt. Sinabung

4. Conclusions

Mt. Merapi and Mt. Sinabung volcanic ash had macronutrient elements, such as K, Mg, Ca and P, which caused the volcanic ash had great potential to agriculture. Then, volcanic ashes were a pozzolan material. Therefore, this material was potential for the synthesis of geopolymer materials. The ratio of SiO_2/Al_2O_3 molecules in Sinabung volcanic ash was 5.26, while in Merapi was 5.84.and then, they had high amorphous minerals and crystalline minerals [feldspar].

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