



# ABSTRACT BOOK

INTERNATIONAL INTERDISCIPLINARY  
CONFERENCE ON ENVIRONMENTAL  
SCIENCES AND SUSTAINABLE  
DEVELOPMENTS  
(IICSSD)

2021

PASCASARJANA

“Environmental Sciences and Sustainability  
Developments towards the Era of Society 5.0”

Swiss Belhotel,  
5-6 December 2021

**RUNDOWN INTERNATIONAL INTERDISCIPLINARY CONFERENCE ON  
ENVIRONMENTAL SCIENCES AND SUSTAINABLE DEVELOPMENT  
(IICSSD) 2021  
POSTGRADUATE TADULAKO UNIVERSITY  
Swiss-Belhotel Palu, December 5-6<sup>th</sup>, 2021**

**OPENING CEREMONY AND KEYNOTE SPEECH**

Date : December 5<sup>th</sup>, 2021.  
Venue : Swiss-Belhotel convention hall, Palu.  
By virtual : Zoom ID [964 5649 4870](#) password: [275547](#)

TIME*	ACTIVITY
<b>OPENING CEREMONY</b>	
18.30-18.45	Registration
18.30-19.30	Welcome dinner
19.30-19.40	Opening by MC – Anita Aswin, S.Pd., M.Pd.
19.40-19.50	Cultural and dance performances
19.50-20.00	National Anthem of Indonesia “Indonesia Raya”
20.00-20.10	Opening prayer by Prof. Dr. H. Juraid Latief, M.Hum.
20.10-20.30	Welcoming Remarks <ol style="list-style-type: none"> <li>Organizing committee</li> <li>Director of Postgraduate Tadulako University</li> <li>Rector of Tadulako University</li> </ol>
<b>KEYNOTE SPEECH</b>	
Panel presentation main speakers Moderator: Prof. Dr. Mery Napitupulu	
20.30-21.30	<ol style="list-style-type: none"> <li>Prof. Dr. Tim Roberts Newcastle University, Australia. <i>“Sustaining the balance of island ecosystems”</i></li> <li>Prof. Dr. Muhammad Basir Cyio Tadulako University <i>“Environmental Recovery and Management of Degraded land”</i></li> </ol>
21.30-21.40	Announcement by organizing committee

\*Central Indonesia Time (UTC+08:00)

**KEYNOTE SPEECH & PAPER PRESENTATION**

Date : December 6<sup>th</sup>, 2021  
Venue : Swiss-Belhotel Palu, Room Silae hall  
By virtual : Zoom ID [964 5649 4870](#) password: [275547](#)

TIME*	ACTIVITY
<b>KEYNOTE SPEECH MORNING SESSION</b>	
Panel presentation main speakers Moderator: Prof. Dr. Marsetyo.	
08.00-08.20	<ol style="list-style-type: none"> <li>Prof. Richard Gelderman Western Kentucky University, USA <i>“Looking Upward and Outward to Understand Changes on Earth”</i></li> </ol>
08.25-08.45	<ol style="list-style-type: none"> <li>Prof. Dr. Miguel A. Altieri University of California, USA <i>“Agroecology: achieving the millennium sustainable goals of 0 hunger and climate action”</i></li> </ol>
08.45-09.30	Q n A
09.30-12.00	Paper presentation morning session
12.00-13.00	Lunch Break
<b>KEYNOTE SPEECH AFTERNOON SESSION</b>	
Panel presentation main speakers Moderator: Andi Arham Adam, ST., M.Sc., PhD	
13.00-13.20	<ol style="list-style-type: none"> <li>Prof. Dr. Bunyamin Maftuh University of Education Indonesia, Indonesia. <i>“Improving Students’ Ecoliteracy through Social Studies for Education Sustainable Development”</i></li> </ol>
13.25-13.45	<ol style="list-style-type: none"> <li>Prof. Dr. Suratman Gadjah Mada University, Indonesia. <i>“Environmental crisis and Sustainable Development”</i></li> </ol>
13.50-14.10	<ol style="list-style-type: none"> <li>Dr. F.X. Suryadi IHE Delft Institute, The Netherlands. <i>“Potential and constraints tidal lowland in Indonesia and its sustainability”</i></li> </ol>
14.15-15.00	Q n A
15.00-17.00	Paper presentation afternoon session
17.00-17.10	Closing

\*Central Indonesia Time (UTC+08:00)

**PAPER PRESENTATION MORNING SESSION GROUP 1**

**Agriculture for the environment and sustainable Development**

Moderator : Prof. Dr. Shahabudin/Dr. Ramal Yusuf.  
 Date : December 6<sup>th</sup>, 2021.  
 Time : **09.30-12.00 Central Indonesia Time**  
 Venue : Swiss-Belhotel Palu, Room Anggrek  
 By virtual : Zoom ID: **927 0040 0439** and password: **group1**

Nr.	Authors	Title
1	Ramal Yusuf, Abdul Syakur, Yulianti Kalaba, Rostiati Rostiati and Suci Ramadani	Flowering of Chrysanthemum ( <i>Crysanthemum</i> sp.) growing under of various concentrations of liquid organic fertilizer
2	Khairuddin Khairuddin, Ruslan Ruslan and Nindya Andarini	Study of phosphate adsorption using ferrihydrite with diffusive gradient in thin films method
3	Bakri Bakri, Naharuddin Naharuddin, Mustafa Mustafa, Kristian Seleng, Sri Chandrabakty, Muhammad Iqbal, Anjar Asmara, Ardiansyah Hasan and Azizah Ayu Safitri	Tensile strength and water absorption of oil palm mesocarp fiber reinforced polyester composites: Effect of volume fraction of fiber
4	I Kadek Suka Artayasa, Mohammad Salim Manabanti, Karimullah Karimullah, Devi Elvina Sari and Samliok Ndobe	Development and trial of an artificial microhabitat for Banggai cardinalfish, the Indonesian marine ornamental mascot
5	Indah Surya Luvi Sangkota, Samliok Ndobe, Jusri Nilawati, Madinawati Madinawati and Desiana Trisnawati Tobigo	Brightness of koi carp ( <i>Cyprinus carpio</i> ) juveniles reared in tanks with different coloured backgrounds
6	Windi Arsry, Nasmia Nasmia, Rusaini Rusaini, Samliok Ndobe, Septina F. Mangitung and Madinawati Madinawati	Control of vibriosis in whiteleg shrimp ( <i>Penaeus vannamei</i> ) using moringa ( <i>Moringa oleifera</i> ) seed extract

Nr.	Authors	Title
7	Vanny Tiwow, Paulus Abram and Walburga Gheje	Eugenol epoxidation of clove oil ( <i>Syzygium aromaticum</i> ) using $K_2Cr_2O_7$ with $H_3PO_4$ catalyst
8	Vanny Tiwow, Paulus Abram and Kiatisak Raksapoln	Investigation of organic fertilizer production on household scale from fish intestine in Thailand and Indonesia
9	Suherman Suherman and Sri Mulyani Sabang	Recovery and improvement of cocoa production with the use of nutrients from chitosan-tonnage blending ash
10	M.S. Arifuddin, A. Yakupitiyage, S. Tumwasorn, G.K. Hansen Hansen and P. Parkpian	Effects of protecting soybean meal protein with formaldehyde on live weight gain of local rams
11	Marsetyo Marsetyo, Y Rusiyantono and I.W. Sulendre	Liveweight gain, change in body dimension and condition score of Donggala bulls fed corn stover supplemented with different tree legume leaves
12	Yohan Rusiyantono, Rusdin, Ismail Wumbu	Increasing of prolificity and reproductive performance of Palu fat tail sheep through superovulation and artificial insemination
13	Asriani Hasanuddin and Rusdi Rusdi	Nutritive values of fermented palm oil sludge with <i>Rhizopus oligosporus</i> and its potential as a functional feed for poultry
14	Zakirah Yala, Dwi Sulistiawati, Nasmia Nasmia and Desiana Tobigo	Multiple biota cultivation (Gracilarias and Chanos-chanos) development model as a pillar of milk fish-agar agroindustry and its applications
15	Nur Edy, Eva Zakaria, Iskandar Lapanjang, Henry Novero Barus and Irwan Lakani	Arbuscular mycorrhizal fungi in cocoa plantation affected by different elevation and soil physical-chemical properties

**PAPER PRESENTATION MORNING SESSION GROUP 2**

**Health for the environment and sustainable development**

Moderator : Purnama Ningsih, Ph.D./Rusaini, Ph.D.  
 Date : December 6<sup>th</sup>, 2021.  
 Time : **09.30-12.00 Central Indonesia Time**  
 Venue : Swiss-Belhotel Palu, Room Edelweis  
 By virtual : Zoom ID: **978 7810 4506** and password: **kesehatan**

Nr.	Authors	Title
1	Nurhaeni Nurhaeni, Ni Ketut Sumarni and Mohamad Junaid	Optimization of Ca, Mg, and Mn adsorption of well water using column system with activated charcoal of moringa peel
2	Nasmia Nasmia, Kusmadi L. Binangkari, Rusaini Rusaini and Muh. Saleh Nurdin	Addition of extract seaweed <i>Sargassum</i> sp. on culture media on the total density of skeletonema costatum cells
3	Sitti Rahmawati and Qonita Kurnia Anjani	The Use of MSG ( <i>Monosodium glutamat</i> ), aloe vera, and papaya leaf ( <i>Carica papaya</i> L) as an alternative of corrosion inhibitor
4	Purnama Ningsih, Sri Mulyani, Ijirana Ijirana and Frischilia Febby Patanda	Etnochemistry study of medicine plants for liver disease in the community of Balane Village
5	NA Salikunna, Kurniawan A, Fitriana Y, Ramadhan MZ	The Relationship Between Pesticide Exposure and Hypertension Incidence on Paddy Farmers in Dolago Padang Village, Central Sulawesi, Indonesia
6	Samliok Ndobe, Muamar Muamar, Eka Rosyida, Irawati Mei Widiastuti, Kasim Mansyur and Fadly Y. Tantu	Effect of adding squid meal as an attractant to freshwater eel ( <i>Anguilla marmorata</i> ) feed on elver growth, feed palatability, efficiency and conversion
7	Ellen Oktanike Merpati, Samliok Ndobe, Rusaini Rusaini, Shahabuddin Saleh, Novalina Serdiati, Septina F. Mangitung and	Detection of Salmonella in bone-free milk fish ( <i>Chanos chanos</i> Forksskal, 1775)

Nr.	Authors	Title
	Desiana Trisnawati Tobigo	
8	Paulus Abram, Vanny Tiwow, Yul Watalee and Mariana Sitandi	Introduction of Aloe vera gel as a natural coagulant for reducing concentration of heavy metals on water purification
9	Ludia Rustin Palondongan, Shahabuddin Saleh and Gatot Siswo Hutomo	Characterization and Evaluation of basil oil ( <i>Ocimum basilicum</i> L.) as Larvicidal and Repellent Against the Yellow fever mosquito
10	Ayu Sekarani Damana Putria, Vera Diana, Rahma Darisb Daris and Fitri Afrianab	Does the presence of praziquantel-related adverse events affected the health community perception toward mass chemopreventive programme in the highest prevalence area of schistosomiasis in Indonesia
11	Asrawati Sofyan, Andi Nur Asrinawaty and Mohammad Salman	Acne due to the wearing of mask in prevention of Covid-19 "MASKNE"
12	Gabriella Bamba Ratih Lintin, Indah Puspari Kiy Demak, Muh. Ardi Munir, Sarifuddin Sarifuddin and Fauziah Amining	Medical students Tadulako University perspective of online learning anatomy practicum during pandemic Covid-19
13	Gina Andyka Hutasoit, Mohammad Salman and Budi Dharmono Tulaka	The comparison of neutrophyl lymphocyte ratio and platelet lymphocyte ratio of length of stay Covid-19 patients at Undata Palu Hospital
14	Miranti Miranti, Suryani Rahman and Diah Mutiarasari	The knowledge level and application of phbs health workers at kaleke health center as an effort to prevent Covid-19
15	Mohammad Salman, Gina Andyka Hutasoit, Mariani Rasjid and Asrawati Sofyan	Unilateral ureteral obstruction lead $\alpha$ -smooth muscle actin expression in swiss webser mice within 7 days
16	Farhadibah Zulmulatifah, Nur Syamsi and Andi Alfia Muthmainnah Tanra	Comparison of the quality of life between elderly living in shelter and at home of the Petobo Village

Nr.	Authors	Title
17	Anita Ahmad, Muhammad Bakri, Irwan Mahmudi, Rahmawati Rahmawati and Zulnabil Zulnabil	Artificial intelligent for human emotion detection with the mel-frequency cepstral coefficient (MFCC)

#### PAPER PRESENTATION AFTERNOON SESSION GROUP 2

#### Health for the environment and sustainable development

Moderator : Purnama Ningsih, Ph.D./Rusaini, Ph.D.

Date : December 6<sup>th</sup>, 2021.

Time : **15.00-17.00 Central Indonesia Time**

Venue : Swiss-Belhotel Palu, Room Silae hall

By virtual : Zoom ID: **978 7810 4506** and password: **kesehatan**

Nr.	Authors	Title
18	Andi Nur Asrinawaty, Puspita Sari and Vera Diana Towidjojo	Implementation of health protocols the employees at faculty of medicine on an adaptation of new normal
19	Budi Tulaka and Jeffrey Ongkowijaya	Association between neutrophil-lymphocyte ratio and vitamin D with clinical severity risk of COVID-19 patients in Manado
20	David Pakaya, Aliyah Rezky Fahira, Sarifuddin Anwar and Gabriella Bamba Ratih Lintin Lintin	Utilization of nanotechnology in metformin delivery: the morphometric study of pancreatic islets of diabetic rat model
21	Haerani Harun, Jihan G Ismail, Sarifuddin Anwar and I Kadek Rupawan Rupawan	Neutrophil lymphocyte ratio (NLR) in smokers
22	Indah Puspasari Kiay Demak, Gabriella Bamba Ratih Lintin and Ilham Armadi	Intra uterine device (IUD) low-cost mannequin as learning resource in clinical skills learning
23	Ketut Suarayasa and Bertin Ayu Wandira	Community-based nutrition monitoring system for toddlers: case study in Palu City
24	Mariani Rasyid, Nur Aisyah Latifah, Asrawati Sofyan and Yuli Fitriana	A woman with pulmonary tuberculosis and morbus hansen - case report
25	Puspita Sari, Vera Diana Towidjojo and Andi Nur Asrinawaty	Covid-19 prevention efforts in the family environment in Binangga Village, Marawola District, Sigi Regency

Nr.	Authors	Title
26	Tri Setyawati, Rabiatal Adawiyah, Rika Marina Walanda, Riski Riski and Raj Chandra	Effectiveness of moringa oleifera on triglyceride levels in diabetic wistar Rats ( <i>Rattus norvegicus</i> ) inducted with streptozotocin
27	Irwan Said, Sitti Aminah, Purnama Ningsih and Saskia Chairunnisa	Optimum conditions for absorption of copper (Cu) from Its solution using durian skin waste biomass ( <i>Durio zibethinus</i> )
28	Sitti Aminah, Irwan Said, Purnama Ningsih and Alfiana Alfiana	Optimum conditions for bioadsorption of lead (Pb) by durian skin biomass ( <i>Durio zibethinus</i> )
29	Gina Andyka Hutasoit, Mohammad Salman and Mariani Rasyid	Overview of the neutrophil-lymphocyte ratio and platelet-lymphocyte ratio on the length of stay of Covid-19 patients at Undata Hospital Palu
30	Alamsyah Alamsyah, Ardi Amir, Mery Subito, Rizana Fauzi Fauzi and Amirullah Amirullah	Performance analysis of breadth first search and depth first search on MANET for health monitoring system
31	Christin Rony Nayoan and Annisa Hayatul Qalbi Thalib Thalib	Risk factors of rhinitis chronic in furniture workers of West Palu, Central Sulawesi.
32	Muhammad Ardi Munir, Pascal Adventra Tandiang and Annisa Istiqamah Ahmad	The relationship between depression levels and people's quality of live at Balaroa temporary shelter in west districts Palu City after natural disaster on September 2018

**PAPER PRESENTATION MORNING SESSION GROUP 3**

**Engineering science for environment and sustainable development**

Moderator : Dr.Eng. Hendra Setiawan/Atur Siregar, S.T., M.Sc., Ph.D.

Date : December 6<sup>th</sup>, 2021.

Time : **09.30-12.00 Central Indonesia Time**

Venue : Swiss-Belhotel Palu, Room Edelweis

By virtual : Zoom ID: **992 2335 5234** and password: **grup3**

Nr.	Authors	Title
1	I Wayan Sutapa, Yassir Arafat, Nina Bariroh R, Sance Lipu and Frederichsen Feter P.	The Effect of climate change on the erosion potential of the Singkoyo Watershed
2	Rahadi Susila and I Gede Tunas	Simulation of daily discharge of Salugan watershed with HEC-HMS model for technical irrigation development
3	Ratnasari Ramlan, Muhammad Arief Setiawan, Novita Pradani and Jurair Patunrangi	Perception and decision of public transport user's in Palu City
4	Nirmalawati Nirman and Wayan Sutapa	Economic feasibility study bifurcation development and toili river flood control Banggai District
5	Donny M. Mangitung, Nirmalawati, Andi H. Azikin, Gitalia R. Ningsih, Musdalifah, Suci S. Ningrum	Important factors influencing the successful implementation of electronic tenders based on the perceptions of consultants, contractors and project owners in Palu
6	Tutang Muhtar, Andi Rusdin, Abdul Wahab, Nirmalawati Nirmalawati and Adnan Fadjar	Risk management in the development of a regional drinking water supply system
7	Yuli Asmi Rahman, Nurhani Amin, Yulius Salu Pirade and Andi	Experimental study of harvest solar energy based on thermoelectric generator with variations of configuration and

Nr.	Authors	Title
	Dhiza Ainun	heatsink
8	Muhammad Bakri, Amar Amar, Anita Ahmad Kasim and Siti Khomaria	Architectural model using local initiative of Kampung Lere fishermen after the tsunami disaster
9	Arief Setiawan, Ratnasari Ramlan, Eko.R Labaso and Abd. Aras Nur	Identification and treatment of black spots in the road network around Universitas Tadulako.
10	Taslim Bahar and Anas Tahir	Examining the intersection performance of the post-disaster permanent housing assistance impact: a study of the trip generation/attraction in Palu City
11	Chauliah Fatma Putri and Muhammad Agus Sabhana	Design of batik dying process tools with value engineering
12	Pudji Astutiek, Zulfitriah Masimming and Sarifuddin Laema	Study of landscape patterns on the shape on the city's physical area in providing benefits of green open space
13	Sutrati Melisa Malik, Hariyadi Salenda and Ardiansyah Winarta	Implementation of the Souraja House façade on the composition of the government building facade in Palu City
14	Gator Timbang, Amar Amar, Muhammad Bakri and Putery Fitriaty	A review of mamasa traditional settlement spaces
15	Rezki Awalia, Rachmat Saleh and Andi Chairul Achsan	Study activities of street vendors in the utilization of space in Tatanga District, Palu City (Case Study : I Gusti Ngurah Rai corridor)
16	Muhammad Najib and Ahda Mulyati	Patterns of utilization of residential spaces affected by the earthquake and tsunami in donggala regency

Nr.	Authors	Title
17	Zeffitni	Geospatial approach to hydromorphological and hydrogeological units of unconfine aquifer for determination of liquefaction vulnerability of Petobo and surrounding areas in central Sulawesi Province
18	Fatmawati Amir, Zet Mallisa, Anwar Dolu and Shyama Maricar	Compressive strength of local natural fiber mortar composite bamboo
19	Ninasafitri and Zeffitni	Potential of confine aquifer based on characteristics of aquifer in phase ia duyu permanent occupancy at Palu City Central Sulawesi Province
20	Andi Rusdin, Yassir Arafat, Sance Lipu, Amar Amar and Tutang Muhtar	Coastal flooding induced by compound events of high tide and high waves

**PAPER PRESENTATION AFTERNOON SESSION GROUP 3**

**Engineering science for environment and sustainable development**

Moderator : Dr.Eng. Hendra Setiawan/Atur Siregar, S.T., M.Sc., Ph.D.  
 Date : December 6<sup>th</sup>, 2021.  
 Time : **15.00-17.00 Central Indonesia Time**  
 Venue : Swiss-Belhotel Palu, Room Edelweis  
 By virtual : Zoom ID: **992 2335 5234** and password: **grup3**

Nr.	Authors	Title
21	Rudi Herman, M. Galib Ishak and Reza Pratama	Scouring analysis of sibado weir in the tompe river
22	Khaerunnisa Laguni, Khairinrahmat Tamala and Fratika Julia	Study of space changes in post disaster Residence in Tondo, Palu City
23	Darman Darman, Syamsul Bachri, Vitayanti Fattah and Syarifah Aliyah Fitrisam	Special treatment for debtors affected by liquefaction natural disaster
24	T. S Sollu, S. Dewi, Alamsyah Alamsyah and A. G Sooi	Internet of things based electric wheelchair control system
25	Sofia Wantasen	Assessment of physical water quality for irrigation purpose
26	Rizana Fauzi, Aydinal Mustari and Rudi Santoso	Monitoring tools for a potential of liquefaction in a region based on the internet of things (IoT) with photovoltaic (PV) sources
27	Gidion Turuallo, A. Arham Adam, Israjuddin M. Yusran, Isti Haryanto, Michael Gelong and Ayu Amalia Porotuo	The maximum percentage of fly ash to replace a part of cement in self-compaction concrete (SCC) mixture to obtain the maximum strength
28	Atur Parhorasan Nusantara Siregar	Effect of partial fly ash as cement substitute on the fracture toughness

Nr.	Authors	Title
29	Hendra Setiawan, Ihzam Ilaiya, Ida Sri Oktaviana, Irdhiani, Iffah Fadliah and Yusfi Hasanah	The study of liquefied soil by using Swedish weight sounding test in Jono Oge Village, Sigi Regency
30	Dhevy Puswiartika, Hasan and Ratman	Dispositional mindfulness as internal resource of the supervisors of railway transportation service provider
31	Sriyati Ramadhani, Martini Martini, Kusnindar Abdul Chauf, Agus Dwijaka and Mohammad Zico Bierhofa	Slope stability using simplified bishop method in Kebun Kopi Donggala Regency Central Sulawesi Province
32	Astri Rahayu, Irianto Uno, Nur Hidayat, Agus Dwijaka and Muhammad Yusuf	Potential of liquifaction at nasanapura hospital Petobo Village Palu City
33	Sri Mulyati, Rizkhi Rizkhi and Salhudin Salhudin	Multi-hazard assessment in Palu Barat District
34	Siti Rahmi Oktavia, Nina Bariroh Rustiati, Vera Wim Andiese, Tuty Amaliah and Oktaviani Ayu Mantika	Baseflow index analysis on miu watershed use digital graphical method
35	Muliati Muliati, Juliana Kadang, Insarullah Insarullah, Nur Edy Nur Edy and Ratnasari Ramlan	Management information system based on study program accreditation instrument Postgraduate at Tadulako University
36	Ahda Mulyati and Zaenal Zaenal	Relationship in the establishment of settlement patterns indigenous communities lack in Central Sulawesi
37	Nur Rahmanina Burhany, Andi Jiba Rifai Bassaleng, Puteri Fitriaty and Andi Marwah	Architectural adaptation of vernacular stilt house in Palu City



Nr.	Authors	Title
38	Dr. Setiyawan, Dr. Saparuddin, Vera Wim Andiese, Fildawati Yuningsi and Wisnu Wardhana	Beach protection model in Palu bay coastal area post tsunami 2018
39	Yassir Arafat, I Wayan Sutapa and Yusfi Hasanah	Climate change impacts on the Palu watershed's precipitation characteristics
40	Fahirah F and Rika Madina	Assessment of occupational health and safety risk in the road construction project in the Sigi Regency

#### PAPER PRESENTATION MORNING SESSION GROUP 4

#### Education for the environment and sustainable development

Moderator : Abdul Kamarudin, Ph.D.

Date : December 6<sup>th</sup>, 2021.

Time : **09.30-12.00 Central Indonesia Time**

Venue : Swiss-Belhotel Palu, Room Tinombala

By virtual : Zoom ID: **976 5468 8652** and password: **education**

Nr.	Authors	Title
1	Daud K. Walanda, Mery Napitupulu, Victor Eferhar Sandewa and Detris Poba	Leveraging educational technology (Hyperdocs) on student's collaboration skills in science learning
2	Khairunnisa Khairunnisa, Aminah Suriaman, Mukrim Mukrim, Konder Manurung and Mochtar Marhum	Students' learning experience in using online learning media in Covid 19 era: a case study of undergraduate students of Tadulako University Palu
3	Pathuddin Pathuddin, Sudarman Bennu and Haerul Yahya	Analysis of student understanding in linking formula to the generalization of figural patterns
4	Syukur Umar, Hendra Pribadi, Abdul Rosyid and Budi Setiawan	Forestry students preferences for online and offline lectures during the Covid-19 period
5	Burhanuddin St. M.Sc, Fuad Zubaidi and Gator Timbang	Social solidarity of the ethnic community of Kaili Da'a Tribe as the former of living space dombu village
6	Luthfiah Thaha, Aziz Budainta and Rachmat Syahrullah	Early childhood school study room based on children's behavioral activities
7	Muhammad Al Gifary, Emi Sulmeini and Ria Dzulhijjah	Students' perception of environmental literacy through education sustainable development-oriented chemistry learning
8	Ismail and Annisaa Kusumaningrum	The understanding of chemistry subject teachers for the material Particulate nature of matter that oriented education for sustainable development

Nr.	Authors	Title
9	Muthia Aryuni	Why does Bullying Happen at School? Investigating of Teacher Attitudes and Perceptions about Bullying and Interventions
10	Yunidar Yunidar, Tamrin Tamrin, M. Asri B and Gusti Alit Suputra	The survival of Kailinese Language: The case of Kailinese students at Tadulako University Palu
11	Afadil Afadil, Akter Puala'A, Ijirana Ijirana, Tri Santoso, Magfirah Magfirah and Sitti Rahmawati	Design and validation of chemistry learning modules STEM-based reaction rate materi
12	Muhammad Nur Ali, Rahmat Bakri and Muthia Aryuni	Perspectives and attitudes in radicalism: exploring of social learning theory
13	Munifah Munifah, Muthia Aryuni and Yusdan Yusdan	The level of self awareness and learning discipline students in the Covid-19 pandemic era
14	Anasthasia Watun, Konder Manurung, Mukrim Mukrim, Aminah Suriaman and Abdul Kamaruddin	Exploring EFL learning strategies of International Class students at higher education
15	Sitti Chaeriah Ahsan, Muhammad Nawawi and Putri Ayu Nabila	Child protection policy implementation in preventing child abuse In Palu City, Central Sulawesi, Indonesia
16	Misnah Misnah, Iskandar Iskandar, Hasan Hasan, Mutawakkil Mutawakkil, Bahri Bahri and Hamlan Andi Baso Malla	Online learning training assistance for teachers in Sigi District in The Covid-19 Pandemic

Nr.	Authors	Title
17	Mutmaina Mutmaina, Hasan Basri, Sriati Usman, Aminah Suriaman, Anshari Syafar and Mawardin Said	Problems faced by the English lecturers in teaching students of Non-English Education Study Program during Covid-19 pandemic
18	Novranda Alifthari, Konder Manurung, Mukrim Mukrim, Aminah Suriaman and Mochtar Marhum	Exploring teachers' perceptions of instructional materials development during pandemic of covid-19: a case study at SMA Al-Azhar Mandiri Palu
19	Liviany Potabuga, Konder Manurung, Rofiqoh Rofiqoh, Aminah Suriaman, Mochtar Marhum and Mawardin Said	Students' perception on the implementation of online learning in public speaking course during Covid-19 pandemic
20	Syarifudin Syarifudin, Hasan Basri, Aminah Suriaman, Anshari Syafar and Sudarkam Mertosono	Investigation of students' perception on English e-learning during Covid-19 pandemic at the eleventh grade
21	Herlina Herlina and Herlina Putri Melani	Development of learning material based on plastic waste processed product in elementary schools

**PAPER PRESENTATION MORNING SESSION GROUP 5**

**Green economy, entrepreneurship and good governance for sustainable developmen**

Moderator : Ponirin, M.Buss., Ph.D.

Date : December 6<sup>th</sup>, 2021.

Time : **09.30-12.00 Central Indonesia Time**

Venue : Swiss-Belhotel Palu, Room Chrysant

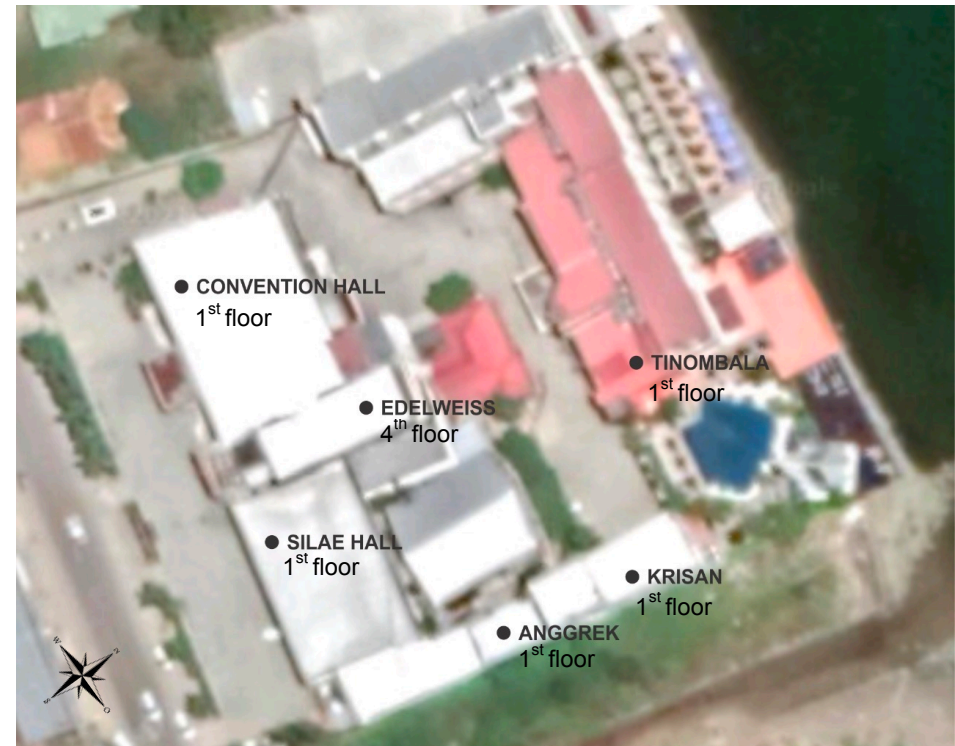
By virtual : Zoom ID: **286 952 3753** and password: **ICESSD**

Nr.	Authors	Title
1	Mahatir Muhammad, Jurana Jurana, Arung Mayapada, Supriadi Laupe, Muliati Muliati and Abdul Kahar	The effect of social visibility and foreign ownership on corporate social responsibility disclosure: an evidence from Indonesia
2	Zakiyah Zahara, Cikal Rambase N and Muslimin Muslimin	The effect of institutional environment toward entrepreneurial marketing and its impact on culinary smes performance during Covid-19 pandemic
3	Suryadi Hadi, Harifuddin Thahir, Muhammad Roy Irawan Mehdi, Noerifma Hidayah, Muhammad Iqbal Abdullah, Fikry Karim and Rombe Elimawaty	Sustainable marine ecotourism in the Togean Islands after the covid-19 pandemic
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# International Interdisciplinary Conference on Environmental Sciences and Sustainable Developments (IICESSD) 2021

5-6 December 2021 - Palu, Indonesia

<b>Keynote/Plenary Speakers</b>	<b>Title</b>
Prof. Dr. Tim Roberts, <i>Newcastle University, Australia</i>	<i>Sustaining the balance of island ecosystems</i>
Prof. Dr. Muhammad Basir Cyio, <i>Tadulako University, Indonesia</i>	<i>Environmental Recovery and Management of Degraded land</i>
Prof. Richard Gelderman, <i>Western Kentucky University, USA</i>	<i>Looking Upward and Outward to Understand Changes on Earth</i>
Prof. Dr. Miguel A. Altieri, <i>University of California, USA</i>	<i>Agroecology: Achieving the Millennium Sustainable Goals of 0 Hunger and Climate Action</i>
Prof. Tomonori Kawakami, <i>Toyama Prefectural University, Japan</i>	<i>Arsenic Removal from Ground Water by Electrolysis System</i>
Prof. Dr. Bunyamin Maftuh, <i>University of Education Indonesia, Indonesia</i>	<i>Improving Students' Ecoliteracy through Social Studies for Education Sustainable Development</i>
Prof. Dr. Suratman, <i>Gadjah Mada University, Indonesia</i>	<i>Environmental Crisis and Sustainable Development</i>
Dr. F. X. Suryadi, <i>IHE Delft Institute, The Netherlands</i>	<i>Potential and Constraints Tidal Lowland in Indonesia and Its Sustainability</i>

# International Interdisciplinary Conference on Environmental Sciences and Sustainable Developments (IICESSD) 2021

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## **Arbuscular mycorrhizal fungi in Cocoa Plantation Affected by Different Elevation and Soil Physical-chemical Properties**

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Irwan Lakani

Arbuscular mycorrhiza fungi (AMF) play an essential role in various agroecosystems since they build symbiosis mutualism with plants. Understanding the differences in the distribution and diversity of AMF in cocoa plants with different elevations is important to explore the bio-ecological aspects of AMF. This study examined the differences in the number and types of AMF spores in cocoa plantations at three different elevations: <500, 500-1000, and >1000 masl. Environmental factors such as the physical and chemical properties of the soil were also investigated. This study found that the number of AMF spores was higher in the lowlands (<500 masl) than in the highlands. Rarefaction curves show that all soil samples taken are adequate for diversity analysis. Multivariate analysis with NMDS followed by the goodness of fit statistical test using the Bray Curtis method showed that a clear distribution pattern in the AMF community structure was significantly influenced by physical and chemical factors of the soil in the form of phosphorus, potassium, sodium, magnesium, total nitrogen, clay, and soil texture.

**Keywords:** Mycorrhiza cocoa diversity elevation soil

# Arbuscular mycorrhizal fungi in cocoa plantation affected by different elevations and soil physical-chemical properties

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**Abstract.** Arbuscular mycorrhiza fungi (AMF) play an essential role in various agroecosystems since they build symbiosis mutualism with plants. Understanding the differences in the distribution and diversity of AMF in cocoa plants with different elevations is important to explore the bio-ecological aspects of AMF. This study examined the differences in the number and types of AMF spores in cocoa plantations at three different elevations: <500, >500-1000, and >1000 masl. Environmental factors such as the physical and chemical properties of the soil were also investigated. This study found that the number of AMF spores was higher in the lowlands (<500 masl) than in the highlands. Rarefaction curves show that all soil samples taken are adequate for diversity analysis. Multivariate analysis with NMDS followed by the goodness of fit statistical test using the Bray Curtis method showed that a clear distribution pattern in the AMF community structure was significantly influenced by chemical and physical factors of the soil in the form of phosphorus, potassium, sodium, magnesium, total nitrogen, clay, and soil texture.

## 1. Introduction

Arbuscular mycorrhizae have considerable essential roles in soil, including helping organic decomposition, translocation of soil nutrients, increasing the ability of plant roots to absorb water, and maintaining the plant against plant pathogen and abiotic stresses [1–6]. Arbuscular mycorrhizae are obligate fungi, where their survival depends on their hosts [7–9]. Mycorrhizal infection begins from the germination of mycorrhizal spores in the soil. The spores, subsequently, form hyphae and appressorium. Then the extra-radical mycelia AMF connect the network between plant roots and the rhizosphere to absorb inorganic nutrients. Infected plant roots by AMF will develop arbuscules as a structure that functions to exchange nutrients between AMF and plants [10].

The role of mycorrhizae in different ecosystems has been widely studied [2]. However, information on the distribution and factors affecting the abundance and diversity of AMF in cocoa plantations at different elevations is still limited. This information is essential to explain the biology and ecology of AMF. Further, the AMF can be used to be developed as a plant symbiont agent that can help fertility and protect plants from pathogen disturbances and extreme environmental conditions, such as drought and salinity stresses.

The cocoa plantations are an agricultural ecosystems that are closely related to AMF [11–13]. Profitable yielding cocoa has been reported to be associated with AMF [14,15]. The elevation may affect different abundance and diversity of AMF [16–18].

Differences in the abundance and diversity of AMF can be influenced by environmental factors, including the number and type of plant vegetation, soil type, the proportion of soil physical structure content, and soil nutrients [19–21]. Previous studies found no significant difference in AMF at different altitudes based on plant diversity with a unimodal pattern [22]. However, few studies reported a different abundance of AMF with increasing or decreasing the elevations [16–18]. In the aspect of soil conditions, soil fertility directly related to the content of N and P is reported to have a significant effect on the presence of AMF [23–26].

This study aimed to examine the effect of the elevations of the cocoa plantation location, soil nutrient content, and soil physical structure on the abundance and diversity of AMF.

## **2. Methodology**

### *2.1. Study sites and soil sampling*

The study was conducted in Central Sulawesi, Indonesia, on three different elevations of cocoa plantations, located in Maku (0-500 m asl), Ue Rani (500-1,000 m asl), and Watumaeta (> 1,000 m asl). The soil cores (5 ´ 20 cm; diameter ´ deep). The soil was then transported to the plant pest and disease laboratory, Faculty of Agriculture Tadulako University.

### *2.2. AMF spore extraction*

The AMF spore extraction was done by protocol pour-filtered followed by modification introduction by INVAM (<https://invam.wvu.edu>). Composite soil materials 200 g with 1 L water were passed on 200-, 125-, and 45-mm sieving, respectively. AMF determination was done on the genus level [11,27].

### *2.3. Soil physical and chemical analysis*

Soil analysis include physical and chemical. Sand, mist, clay, and class texture were measured for soil physical analysis. Also, pH determined by electrometry method; P, K, Na, Ca, Mg, cation exchange capacity (CEC) were measured by using NH<sub>4</sub>OAC 1N pH 7 protocol; total N was calculated by using Kjeldahl method, and C organic was measured by Walkey and Black protocol [28–31].



## 2.4. Data analysis

A rarefaction curve was applied to estimate the sufficiency of the soil sample used in this study for diversity analysis. Then, the Shannon diversity index was applied, and non-metric dimensional scaling (NMDS) was used to determine dissimilarities of AMF in different elevations of cocoa plantations with the Bray Curtis method. Those analyses were run on PAST version 4.08 [32]. Soil physical and chemical effect on AMF was used as environmental variables on NMDS then subjected to calculate the goodness of fit statistics ( $R^2$ ) to determine the significant variable tested. The analysis was conducted in R (version R 4.11) and R Studio (version 1.4.1717) by using `envfit` function Vegan package [33–35].

## 3. Results and discussion

### 3.1. Abundance and diversity of AMF in different elevations

A total of 2,266 spores were collected from the study sites. Table 1 shows that the higher the elevation, the lower the spores of AMF present. On the elevations of > 500 - 1,000 and > 1,000 m asl doesn't show big differences of AMF spores collected. Compared to the elevation of < 500 m asl, the spore increases twice.

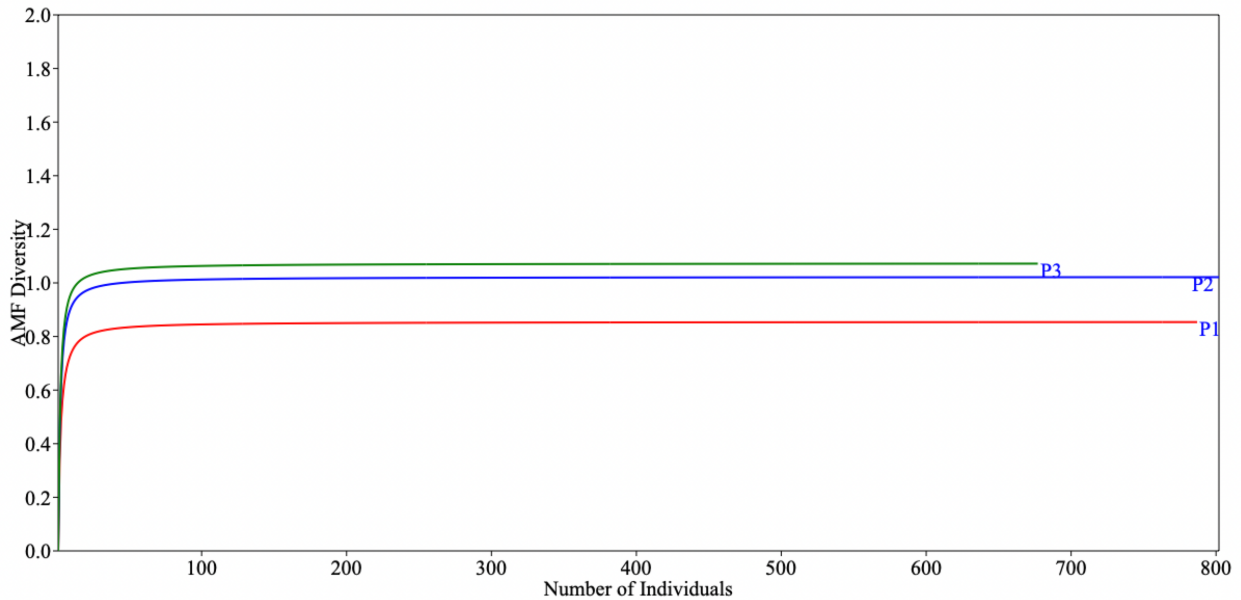
The rarefaction curve shows that all samples collected from different elevations reached the plateau line at a chosen number of samples (Figure 1), which means that the samples are adequate for further diversity analysis. Similar to the abundance of AMF, the Shannon diversity index shows the same pattern. The lower elevation shows higher diversity than the lower elevation (Figure 2).

The hypothesis related to this study may cause by above-ground vegetation and soil climate condition [36–39]. Until now, information about AMF colonization's specifics in certain plants remains a question. A general point of view relates the between AMF and plants as different ecological strategies indicating functional groups form based on ecosystem conditions. The previous study has shown differences in the composition of the AMF community, for example, found in grasslands, vegetable crops, trees, forests or in certain plant species [36,40–43].

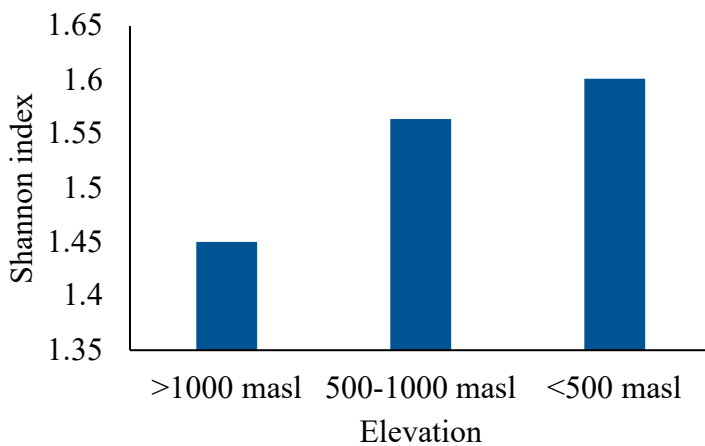
In addition, environmental climate conditions may also influence the abundance of AMF. Sosa-Hernández et al. [39], reported the abundant and unique community of AMF in subsoil adapted to the soil rhizosphere conditions.

**Table 1.** The abundance of AMF in different elevation of cocoa plantation

Elevation (m asl)	Number of AMF spore
< 500	1,175
> 500 - 1,000	496
> 1,000	595



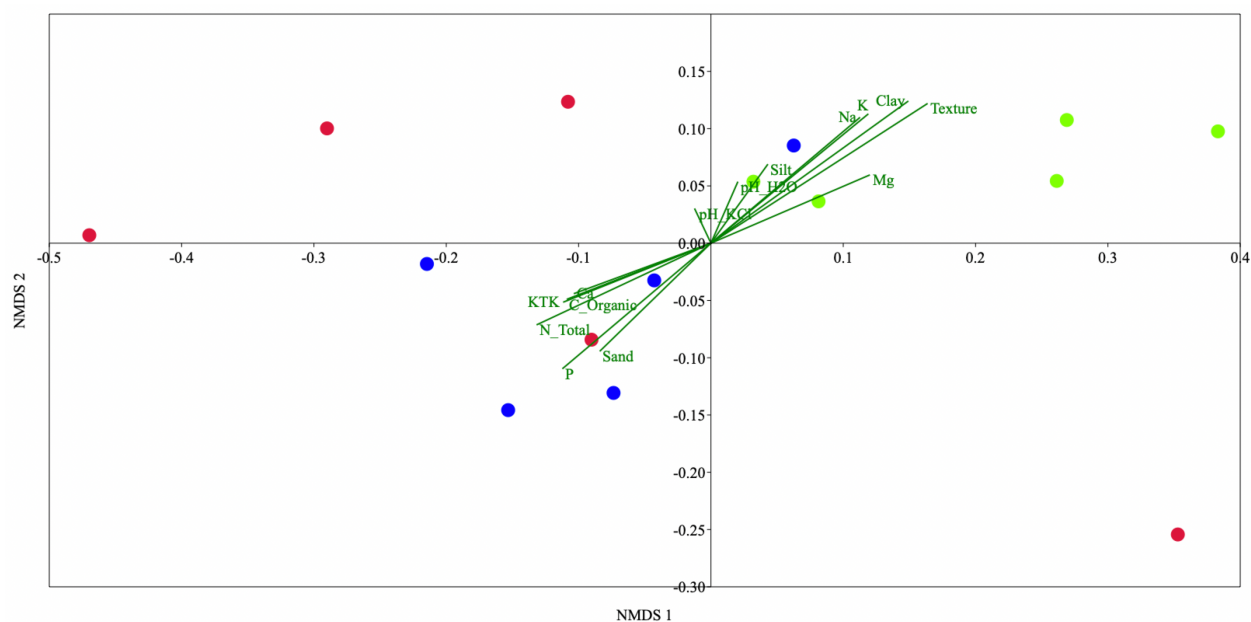
**Figure 1.** Rarefaction curve of sampling effort on AMF in different elevation of cocoa plantation. P1: elevation > 500 - 1,000 m asl; P2: elevation of > 1,000; P3 elevation of < 500 m asl.



**Figure 1.** Shannon diversity index of AMF in different elevation of cocoa plantation

### 3.2. AMF communities affected by elevation and soil properties

The non-metric multidimensional scaling (NMDS) was applied to assess the community structure of AMF in different elevations. Environmental factors involved were pH, P, K, Na, Ca, Mg, CEC, N total, C organic, sand content, mist content, clay content, and soil texture (Figure 2). The NMDS stress was 0.07, an accepted value that explains low error distance between samples and low similarity in the group assessed. Additionally, the environmental factors determined showed that P, K, Na, Mg, N total, clay content, and soil texture were related to AMF community structures in different elevations ( $p < 0.05$ ) (Table 2).



**Figure 2.** Ordination of NMDS of AMF communities using the Bray-Curtis dissimilarity to environmental factors that influence it.

**Table 2.** Goodness of fit ( $R^2$ ) statistics of AMF and environmental factors according to NMDS ordination. The significance is based on the 999 permutations.

Environmental Variable	$R^2$	$P$
pH H2O	0.0949	0.624
pH KCl	0.0629	0.789
P	0.4063	<b>0.021*</b>
K	0.4397	<b>0.013 *</b>
Na	0.4085	<b>0.017 *</b>
Ca	0.2347	0.144
Mg	0.3124	<b>0.053*</b>
CEC	0.2707	0.105
N Total	0.3778	<b>0.029 *</b>
C Organic	0.2582	0.104
Sand	0.2795	0.100
Mist	0.1430	0.421
Clay	0.5979	<b>0.003 **</b>
Soil texture	0.6581	<b>0.002 **</b>

Mycorrhizal diversity in ecosystems is influenced by many factors, including biotic and abiotic factors. The role of AMF in phosphorous and nitrogen uptake has been studied broadly. However, limited studies have explicitly discussed the relation of AMF to K, Na, and CEC. A study related to available potassium concentration has been reported by Song et al.[44], which shows that available P and K are the most edaphic factors affecting the AMF communities in soil.

Related to sodium (Na) in soil, AMF has been reported to help the plant adapt to the saline condition [45–47]. A meta-analysis has proven the ability of AMF to absorb water and nutrients in soil conditions with saline conditions [48]. Thus, plants will be more efficient in carrying out photosynthesis and maintaining nutritional stability to form a resistance system to salinity stress. The ability of plants to resist salinity is influenced by the ability of AMF to produce antioxidant enzymes [49].

Soil CEC is one of the fertility indicators. Cation exchange capacity refers to clay content, type of clay, and organic compound content in the soil. CEC variation in different ecosystems is related to humus and clay proportions [50,51]. The higher CEC is related to soil fertility. Here in this study, CEC is one of the soil indicators significantly related to AMF community structure in different elevations of AMF. This study found that clay content and soil texture are significantly related to AMF community structure on soil physical properties. Soil texture, in this study sites, vary on sandy loam to clay sandy loam.

### **Conclusion**

The AMF spore abundance and diversity was higher in the low elevation of cocoa plantations. Assessing the environmental factors related to the soil chemical and physical properties, P, K, Na, Mg, N total, clay content, and soil texture was significantly related to the community structures of AMF. Our results suggested that AMF triggered and contributed to the agricultural ecosystem of cocoa in different elevations. Thus, the AMF can be developed as potential agents to support the cocoa plantation ecosystem and production.

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### **Author Contribution**

The study was developed by NE and IL. Fieldwork and AMF spore extraction by EZ. Soil analysis managed by NE. Data analysis by NE, AA, HNB, and IL. Draft preparation by NE, AA, and SS. Article final review by NE. Funding acquisition by NE and AA.

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