Security in
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medicines

SFRN 2019

PROCEEDING

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3rd INTERNATIONAL CONFERENCE ON SECURITY IN FOOD, RENEWABLE RESOURCES, AND NATURAL MEDICINES 2019 (SFRN 2019)

hosted by,
Politeknik Pertanian
Negeri Payakumbuh

Convention Hall Politeknik Pertanian Negeri Payakumbuh
INDONESIA

co -Hosted by,
Universitas Andalas
(UNAND)

QUANTUM-LEAP OF AGRI-FOOD SYSTEM 4.0 AND DELIVERY OF SUSTAINABLE DEVELOPMENTS GOALS (SDGS)

September 25-26, 2019

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Welcome Message
Executive Chairman of The 3rd International Conference on Security in Food, Renewable resources, and Natural Medicines (SFRN) 2019

Dear Honorable ladies and gentlemen,

Good Morning and Assalamu'alaikum wr.wb

On behalf of the SFRN 2019 organizing committee, I am really honoured and delighted to welcome all of you to the 3rd International Conference on Security in Food, Renewable resources, and Natural Medicines (SFRN) 2019 at the State Polytechnic of Agriculture Payakumbuh, West Sumatra Indonesia

Our technical program is rich and varied with 8 keynote speeches and 4 invited talks and more than 170 technical papers split between 8 parallel oral sessions and 1 poster sessions. The speakers and participants came from 8 different countries, consist of Academicians, Scientists, Researchers, Practitioners, Professionals, and Government Officialsin multidiscipline branch of knowledge, who gathered here today to share and discuss new findings and applications of innovations for promoting Food Security, Renewable Energy, Sustainable Resources and HealthCare Free for All, in particular for those who in needs. As the chairman of conference 2019 SFRN, I know that the success of the conference depends ultimately on the how many people who have worked in planning and organizing both the technical program and supporting social arrangements. This year, the conference is jointly organized by the Payakumbuh State Agricultural Polytechnic and Andalas University. We also thank to the steering committee fortheir wise and brilliant advice on organizing the technical program; and also to the the Program Committee, both from the Payakumbuh State Agricultural Polytechnic and Andalas University , for their thorough and timely reviewing of the papersand to the Directorof Payakumbuh State Agricultural Polytechnic and the rector of Andalas University, and the Head of the Institute forResearch and Community Service of Andalas University, and Payakumbuh State Agricultural Polytechnic. Our recognition should go to the Organizing Committee members who have all worked really hard for the details of the important aspects of the conferenceprograms and social activities, and then we extend our gratitude to our students who bore the arduous burden for preparing this event.

We hope this event is also a good step in gaining strengthenn cooperation between our universities as we know that the State Agricultural Polytechnicof Payakumbuh is part of the Andalas University previously, of course the psychological relationship between the State Agricultural Polytechnicand the Andalas University is really close.

Finally on behalf of the committee, we apologize profusely for all the shortcomings and everything that is not properly in organizing this event and hopefully AES-Network contributes significantly to the research and technology for the good of humanity.

Thank you

Fithra Herdian, S.TP, MP

Message from Afro-Eurasia Scientific (AES) Network
3rd International Conference on Security in Food, Renewable resources, and Natural Medicines (SFRN) 2019

Dear Honorable and Distinguished guests,
Ladies and gentlemen,

Assalamu'alaikum Warahmatullahi Wabarakatuh and Good Morning

On behalf of the AES Network, I am honored and delighted to welcome you to the 3rdInternational Conference on Security in Food, Renewable resources, and Natural Medicines (SFRN) 2019 at the Agricultural State Poly Technique of Payakumbuh, Indonesia. I believe we have chosen a venue that guarantees a successful technical conference amid the culture, delicacy and scenery of Payakumbuh, the city of "Rendang".

The AES-Network aims to Promote Livelihood Through Food Security, Promote Future Smart and Green Mobility by Using Renewable Energy, Promote Prosperity by Equally Managing and Distributing the Sustainable Resources and Promoting Enjoyable Long-Life by using Natural Medicines With Free Health Care For All. The AES-Network was established in 2018 and already have memberships from 12 countries. Our members consist of Academicians, Scientists, Researchers, practitioners, professionals, and government officials from multidiscipline branch of knowledge, who gathered and contributed their expertise to share and discuss new findings and applications of innovations for promoting Food Security, Renewable Energy, Sustainable Resources and Free Health Care for All.In particular, the network aims to alleviate the condition of those who in dire needs. In the future, we also expect to provide technical demonstrations, and numerous opportunities for informal networking for Promoting Food Security, Renewable Energy, Sustainable Resources and Free Health Care for All. In this opportunity, we invited you to become our members and join our efforts for a better life to all of mankind.

As a team, we acknowledge the existence of mutual interest among university and college educators, researchers, activists, business sector, entrepreneurs, policy makers, and all society members. We must promote the need to strengthen cooperation for establishing Security in Food, Renewable Resources, and Natural Medicines in Africa, Europe, and Asia.

The AES-Network believe, a firm foundation for mutual collaboration with the spirit of equality and partnership and thereby contribute towards sustainable development in these three regions.

Therefore, through networking, friendships, and joint efforts, the capacity of our network can be enhanced to address major challenges in securing the Food, Renewable Resources, and Natural Medicines in Africa, Europa, and Asia.Our Network goals areto increase the awareness of educators, researchers, scientific community, business sector, entrepreneurs, and policy makers in Africa, Europa, and Asia, that the future of a better world, lies within their responsibilities, and to improve the networking, mobility and mutual collaboration of scientific community, business sector, entrepreneurs, and policy makers in Africa, Europe, and Asia to energize the delivery of Sustainable Development Goals.

Finally, I hope that, by registering our network, you will be provideda common platform and support the exchange of knowledge, while at the same time, we offer constructive dialogue across and within the various interest and stakeholder groups, including the intended beneficiaries, and arrived at the best solutions to our terminal goal, Promoting Food Security, Renewable Energy, Sustainable Resources and Free Health Care based on scientific evidence in Africa, Europa, and Asianregion.

Thank You for Joining us!

President
Assoc. Prof. Dr. Eng. Muhammad Makky

Welcome Message
Head of Institute for Research and Community Service
Universitas Andalas

Dear Honorable and Distinguished guests,
Ladies and gentlemen,

Assalamu'alaikum Warahmatullahi Wabarakatuh and Good Morning

It is with great pleasure that I welcome the participants of the SFRN 2019 in Payakumbuh, the city of "Rendang", the prime of Indonesian delicacy.

In this esteem event, we share the knowledges, and imparted it to the people. The quest for knowledge has been from the beginning of time but knowledge only becomes valuable when it is disseminated and applied to benefit humankind. It is hoped that this conference will become a platform to gather and disseminate the latest knowledge which can be adopted for securing the food, resources, and health for mankind, in Asian, European and African region.

Academicians, Scientist, Researchers and practitioners from multidiscipline branch of knowledge who gathered here today will be able to share and discuss new findings and applications of innovations for ensuring food security, in particular for those who reside in developing countries. It is envisaged that the intellectual discourse will result in future collaborations between universities, research institutions and industry both locally and internationally. In particular it is expected that focus will be given to issues on environmental and sustainability. Therefore, we urge to all participants, to establish a scientific network that will voice the needs

Researchers in the multi sectoral aspects related to the benefit of mankind have been progressing worldwide. Food is a basic right, while energy drive the world. Human need a lot of resources so the civilization can be flourished. But human is not immune, and thus, ones need to take care of their health regularly. Modern Agri-food systems is the foundations of a decent life, a sound education and the achievement of the Sustainable Development Goals. Over the past decade, we have witnessed a chain reaction that threatens the very foundations of life for millions of the world's people. Rising energy prices drove up the cost of food and ate away the savings that people otherwise would have spent on health care or education. Unsustainable plantation management induced forest fire and posed haze hazard to the whole Sumatra island and our neighboring countries.

The human cost of the food and energy crisis has been enormous. Millions of families have been pushed into poverty and hunger. Thousands more suffering from the collateral effects. Over the past year, food insecurity led to political unrest in some 30 countries. Yet because the underlying problems persist, we will continue to experience such crises, again and again -- unless we act now. That is why we are here today.

We must make significant changes to feed ourselves, and most especially, to safeguard the poorest and most vulnerable. We must ensure safety nets for those who cannot afford food, or energy, nor even a health service. We must transform agricultural development, markets and how resources is distributed. We must do so based on a thorough understanding of the issues. That is the only possible way we can meet the Goals of Sustainable Development.

Thank You,

Assoc. Prof. Dr.-Ing. Uyung Gatot S. Dinata,MT.

Opening Ceremony
Rector of Andalas University

Dear Honorable and Distinguished guests,
Ladies and gentlemen,

Assalamu'alaikum Warahmatullahi Wabarakatuh and Good Morning

I welcome the opportunity to address you at this important event.

It gives me great pleasure in welcoming you to this 3rdConference on "Security in Food, Renewable resources, and Natural Medicines (SFRN)" 2019. I am delighted that so many have accepted our invitation. I am particularly happy that we have in this room, dedicated individuals from so many stakeholder groups — including our most respected and distinguished guest "The ministry of Agriculture of the Republic of Indonesia". We also welcome the mayor of Payakumbuh and the Regent of Lima Puluh Kota. We extend our welcome to the civil society, the private sector, international organizations; the science community; and others dedicated to help create an environment in which people can escape food insecurity. Imagine what we can do together if we make the security for all as an our top priority, and pull in the same direction. We can make a difference in the lives of millions.

Food is a basic right. Food security are the foundations of a decent life, a sound education and the achievement of the Sustainable Development Goals Access to medicines - a fundamental element of the right to health. Health is a fundamental human right, indispensable for the exercise of many other rights in particular the right to development, and necessary for living a life in dignity. Moreover, human rights principles and language are being used to support resource access claims as rights-based approaches empower individuals and groups to gain or maintain access to natural resources

Much progress has been made during the last decades but much more needs to be done. Millions of people are Insecure worldwide, meaning that they either starve or they do not know from where their next meal, health care or resources will come.

Much of the progress on security has occurred at the expense of our environment. With business as usual, we foresee that the production improvements during the next decade will be less than the last one, while the environmental degradation will continue, and health will deteriorate significantly. Without available resources to seek, mankind will become endanger species in a very short time.

Solutions to the security problems need to be designed and implemented within a new and rapidly changing environment. Globalization and sweeping technological changes offer new opportunities for solving these problems. A number driving forces or trends must be taken into account in developing appropriate action. Some of the action needed, such as appropriate technology for small farms, is not new but it must be cast in the new and changing global and national environment, taking into account new opportunities and risks. I hope that by providing a forum for knowledge exchange, this conference will help identify the action to be taken. Furthermore, this conference will help to provide constructive dialogue across and within the various interest and stakeholder groups, including the intended beneficiaries, and arrive at the best solutions.

In conclusion, even if those responsible give high priority to achieving sustainable security for all and back it up with action, the world may not achieve the goal by 2030. But we will be much closer than with business as usual. I urge all of us to provide the strongest support for this event, to enable securing the food for all in the closest time possible. It is my sincere optimism that through the accomplishment of the objectives of this event, we will come to an important step nearer to secure the food for all.

Finally, I would like to thank the organizing committee who have spent their utmost efforts to prepare and manage this event successfully. Let me conclude my remarks by wishing our guests happiness, good luck and great success in the conference.

May I announce now the opening of the "3rd International Conference on Security in Food, Renewable resources, and Natural Medicines (SFRN) 2019" in Payakumbuh.

Thank you.

Rector,
Prof. Tafdil Husni, SE, MBA, PhD

Welcome Message
Director of Politeknik Pertanian Negeri Payakumbuh

Dear Honorable ladies and gentlemen,

Good Morning and Assalamu'alaikumwr.wb

I congratulate to all participants on the invitation and participate at our beloved campus Payakumbuh StateAgricultural Polytechnic. I feel really honoured to welcome all of you at our event, the 3rd International Conference on Security in Food, Renewable Resources, and Natural Medicines (SFRN) 2019 at thePayakumbuh State Agricultural Polytechnic, Indonesia.

Food security is a very important aspect in a country's sovereignty. Food also determines the future direction of a nation. Many social and political fluctuation can also occur if food security is disrupted. Food availability that is smaller than its needs can create economic instability. This critical food condition can even endanger economic and national stability. In the current situation, there are many challenges in exteriorize food security, such as climate change, population, limited natural resources and other challenges both locally, regionally and globally.

Renewable resources are also our starting point to start sustainable development. Research on renewable resources is also very important as the solution in meeting the principles of sustainable development. As we know that Sustainable development is the development that meets the needs of the present without compromising the ability of future generations to meet their own needs.

Sustainability is the foundation for today's leading global framework for international cooperation - the 2030 Agenda for Sustainable Development and its Sustainable Development Goals (SDGs)

The discovery of treatment based on local culture also contributes greatly to the good of humanity. Unfortunately, there are still many treatments that have not been carried out by scientific research. So, through this conferencewe hope it can be a trigger to increase in traditional plant-based treatments that not go through complex chemical processes, so that the effectiveness of the pillars can be further suppressed and also contribute to the community's economy.

Finally, I would like to express my gratitude to all people who involved in organizing this event and to all ofstakeholders who have helped to make this event go on succesfully. Please accept my apologize for any shortage, Assalamu'alaikumwr.wb.

Thank you

Ir. Elvin Hasman, MP

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Stock and Particulate Organic Matter of Ultisols Under Selected Land Use in Wet Tropical Area, Limau Manis West Sumatra, Indonesia

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Abstract. Particulate Organic Matter (POM) is considered an indicator of soil quality. The concentration of POC in Ultisol, a suboptimal soil dominantly found in West Sumatra, was seemed to be affected by the management of the soil. A research conducted in wet (>5000 mm annual rainfall) tropical area aimed to determine POM content of Ultisols under different types of land use. Soil sampling was taken from 0-20 cm and 20-40 cm soil depths under four types of land use (zalacca, uncaria, bush, and seasonal crop) and forest as a comparison. Soil POM content was separated from TOM by using the method introduced by Cambardella and Elliot (1992). The data resulted was compared to forest land use by using a t-test at 5% level of significance. The results showed that POM dominated total soil organic matter (SOM) of Ultisols Limau Manis under wet tropical area. It was found that around 82-88% of total SOM was in the form of POM at the top 0-20 cm soil depth, and 79-84% at the lower (20-40 cm) depth of Ultisols. The content of the POC linearly correlated to TOM content either at 0-20 cm (R^2=0.99) or the lower 20-40 cm soil depth (R^2=0.96). Land-use change from forest to Zalacca, to bush, to Uncaria, and seasonal cropland use decreased the POM content by 3% (P>0.05), by 37% (P<0.001), by 39% (P<0.001), and 42% (P<0.001) after 15 years, respectively for the first 0-20 cm soil depth. At the lower (20-40 cm) soil depth, the tendency of POM content followed the top 0-20 cm depth. The value of the C/N ratio followed the trend of POM (R^2=0.36) on the top 20 cm soil depth, but less correlated (R^2=0.29) on the lower (20-40 cm) depth. It was concluded that after >15 years, intensive cultivation of Ultisols for seasonal crops in the wet tropical area decreased almost half of the POM, even though OM was regularly added to the soil. On the other hand, there was a <5 % reduction in POM content of the soil under less cultivated land under Zalacca land use.

Keywords: POM, land use, Ultisols, cultivation, wet tropical area

INTRODUCTION

Soil organic matter (SOM), which is mainly consisted of soil organic carbon, is known as an ameliorant in soils, either for soil physical, chemical, or biological properties. Organic matter (OM) in the soil is derived from plant or animal residues, both decayed or undecayed materials, either still original or associated with soil.

One part of soil organic matter (SOM), which is coarse and undecomposed, is known as particulate organic matter (POM). Mirsky *et al*. (2008) reported that POM is an indicator of soil quality.

In soils, POM having 0.053-2.000mm in size (Cambardella and Elliot, 1992) or > 53 um (Guimaraes *et al*., 2013) can be found freely or occluded within soil aggregates. It is very susceptible to degradation, such as due to cultivation. Particulate organic matter content in the soil will decrease as tillage intensity increases in the soil. As reported by Figuieiredo (2010), POM was a component of SOM, which is labile biologically, chemically active, and easy to decompose. Previously, Carter *et al*. (2003) also reported that POM in the temperate region (the US and Canada) was profoundly affected by the agroecosystem and the management introduced to the soil. The POM content of the soil under cultivated land for annual crops was approximately 11-37% of the total SOM. Cambardella and Elliot (1992) found POM up to 39% in native sod in Australia.

A tropical region has high both rainfall, and temperature causes very intensive soil organic matter decomposition. Therefore, the OM content of soils tends to be quite low in most tropical soils, such as Ultisols (Yulnafatmawita, 2006; Yulnafatmawita *et al*., 2013), even though vegetation can grow well all year long as the SOM source. Yulnafatmawita and Yasin (2018) reported that the SOM content of the rice field, intensively cultivated, was much lower than grassland in Padang city, wet tropical region. In Brazilian Oxisol, POC was highly found in the aggregates having 8-19 mm in size and lower in smaller aggregate sizes (Ferreira *et al.,* 2017).

Generally, POM is the most sensitive SOM or first disappears or degrades as input energy introduced to a piece of land. It is very susceptible to soil tillage, as reported by Fronning *et al.* (2008), that the POM content in soil decreased as affected by farming practices without returning crop residues as a source of OM to the land. Furthermore, they explained that there was a decrease of OM by almost 50% in land cultivated without external input of OM. Cambardella dan Elliot (1992) stated that POM was reduced as soil with native sod was cultivated into either no-till, stand mulch, or bare soil. Yulnafatmawita *et al.* (2005) and Yulnafatmawita (2006) found that the degree of SOM oxidation linearly correlated to tillage intensity.

Loess *et al*. (2013) reported that POM and total organic matter (TOM) under grassland integrated with raising animals gave higher soil POM and TOM than those under no-till and natural vegetation in Cerrado, Brazil. As also reported by Bhattacharyya *et al*. (2012), no-till practice at rainfed agriculture in Himalaya, India, increased the POM content of the soil. It improved the aggregation process as well as land productivity. Particulate OM, besides dissolved OM, was considered as the most sensitive soil quality indicator (da Rocha Jr *et al.,* 2014). They explained that among the land use studied, the forest was the most resistant soil to degrade.

MATERIAL AND METHODS

This research was conducted in Limau Manis, a wet tropical area in West Sumatra Indonesia. The soil is dominated by Ultisols (tropoudult). The geographical position is between 100°22'-101°42'E and between 0°54'-0°56' S, and the altitude between 250 – 400 m asl. The area receives approximately 5000 mm annual rainfall (Yulnafatmawita *et al*., 2010) with > 9 months of the year is wet. The period of the wet season is used to be between September and January, and the rest is considered a dry season. This area has many species of tropical vegetation. However, some of the areas were opened and changed into farming land and other purposes. The land use selected for this research was under forest, zalacca (*salak*), bushland, uncaria (*gambir*), and seasonal crop (corn, soybean, peanuts, vegetables etc.) farming.

From each land use selected, undisturbed and disturbed soil samples were collected from two depths (0-20 cm and 20-40 cm) for analyzing POM and TOM of soil. Separation of POM from the total OM was conducted using a method introduced by Cambardiella dan Elliot (1992). Then, SOC was analyzed using wet oxidation, N-total using digestion, texture using sieve and pipette method, and bulk density using soil core (BPT, 2006). Soil organic matter content and stock were calculated by using the following formulas:

SOM content (%) = SOC * 1.724 ....%
SOM Stock (Mg/ha) = SOM content * ρb * Vt

SOM = soil organic matter
SOC = soil organic carbon
'ρb = soil bulk density (Mg/m^3)
Vt = total soil volume

RESULTS AND DISCUSSION

A. Profile of Research Area

The research area is located in Karamunting Hill, Limau Manis. It is about 15 km in the eastern part of Padang city, West Sumatra Capital. The area is at a narrow cavity found on the west side of Bukit Barisan Mountain. The topography of the area was gradual to hilly. The slope was between 10-17%.

The soil in this research area was dominated by Ultisols (Imbang *et al*., 1994). This Ultisol was created under wet-humid tropics having quite high annual rainfall. Yulnfatmawita *et al*. (2010, 2014) found that the area received up to 5000 mm/year. Even, in the upper part of the research area, Bukit Pinang-Pinang, the rainfall reached 6500 mm/year (Rasyidin,1994). Soil formation process dominant in this area was weathering and leaching due to its high rainfall. Therefore, the soil became low base saturation, high acidic cations, and clay in texture.

Most of the soil surface was covered by *Imperata cylindrica L.*, *Themeda giganta L.*,*Rhodomyrtus tomentosa L.*,*Melastoma malabathricum*, *Ageratum* *conyzoides L, and Gleichenia spp*. Those plants were an indicator of acid soils. Besides forest and bush, the area was also planted with zalacca, uncaria, and some seasonal crops such as corn, soybean, peanut, and other vegetables.

Zalacca crop was a perennial fruit crop that was first planted about 15 years ago, with planting spacing 2.5 x 2.5 m for approximately 1 ha in this research area. Land conversion from forest to zalacca plantation was conducted by slash and burning. Zalacca crops were not fertilized for the growth. However, the leaves were regularly cut and put between the crops. Therefore, the zalacca area had more litter on the top, and the soil was dark.

In other locations, in the research areas were planted with Uncaria (*Gambir*), a plantation crop to get the leaf extract, with planting spacing 2 x 2 m. The land was used for annual crop farming before planting uncaria. During the growth, uncaria was fertilized every six months, and the soil around the trees was cultivated. Fertilizer used was 15 g/tree with ratio 1:1:1 for Urea, TSP, and KCl. Soil surface in this uncaria planting area was covered by grass.

The land next to uncaria plantation was used for seasonal crops, such as vegetables, onion, soybean, peanut, etc., having < 1-year-old crops. For that, the soil was conventionally cultivated. The crops were fertilized using organic and inorganic fertilizers. This land was planted twice a year, and then it was fallowed until the following year. Therefore, the land was also covered by some weeds before it was cultivated again.

In between planted land, there was some bush with dominant vegetation *Melastoma malabathricum*. This land was found after clearing forests and planted by some cash crops and then abandoned for a long time. Then, some lands in the research area were still covered by secondary forest, especially the area having an altitude of ≥430 m *asl*. The plant canopy of the area was very dense, and the litter was thick enough on the floor, as well as no sunlight reaching the soil surface.

B. Total and Particulate Organic Carbon

Stock SOC and POC, soil BD, total-N, as well as the C/N ratio of Ultisol from several types of land use under wet tropical area were presented in Table 1, while the relationship between SOC as well as POC and soil BD and total N was presented in Figure 1.

Stock SOC	Depth cm	TOC	POC	BD	Stock SOC	Stock POC	POC/ SOC	Total-N	N Stock	C/N
		(%)		(Kg m-3)	Mg ha-1			%	Mg ha-1	
Forest	0-20	3.92	3.46	1173	78.40	69.20	0.88	0.24	5.55	16.56
	20-40	1.87	1.56	1333	37.40	31.20	0.83	0.15	4.09	12.20
Zalacca	0-20	3.95	3.34	963	79.00	66.80	0.85	0.22	4.17	18.23
	20-40	2.35	1.95	990	47.00	39.00	0.83	0.20	4.03	11.56
Bush	0-20	2.51	2.19	1140	50.20	43.80	0.87	0.21	4.71	12.15
	20-40	1.53	1.15	1180	30.60	23.00	0.75	0.12	2.75	13.11
Uncaria	0-20	2.57	2.11	1283	51.40	42.20	0.82	0.20	5.13	12.85

	20-40	1.85	1.45	1340	37.00	29.00	0.78	0.12	3.31	15.00
Seasonal	0-20	2.4	2.02	1097	48.00	40.40	0.84	0.29	6.29	8.37
	20-40	1.65	1.39	1160	33.00	27.80	0.84	0.16	3.63	10.53

Figure 1 shows that organic carbon content was different due to land use and depth. Generally, total carbon organic content at the first 20 cm soil depth was higher than that at the lower (20-40 cm) depth (Fig. 1 A). This trend was followed by the POC content (Fig. 1 B) of the soil. It is due to the source of the OC that was mostly derived from the above-ground, such as litter, leaves, etc. Meanwhile, the underground source of SOC comes from soil organisms as well as from plant roots, and some soil fauna. As reported by Sherrod *et al*. (2002), the POC content of soil decreased by increasing soil depth.

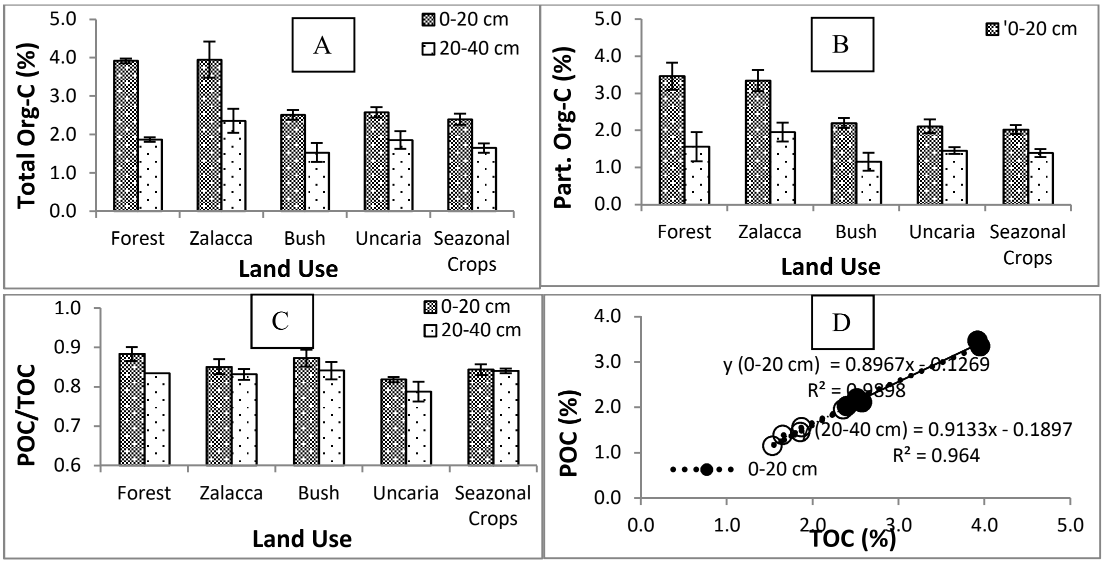

Figure 1. Total (TOC) and particulate organic carbon (POC) of Ultisol on the top 20 cm and 20-40 cm soil depth, under selected land use in the wet tropical area (A=%TOC, B=%POC, C=POC/TOC, D=Linear regression between POC and TOC)

Figure 1 A also describes that the TOC content of Oxisols at different land use showed a different amount. This difference was due to the difference of litter received by the soil as affected by the types of vegetation growing on it.

Forest had higher TOC than that of Uncaria, bush, and seasonal cropland, but approximately the same as that at zalacca land on the top 20 cm soil depth. Higher TOC in the forest was due to dense vegetation and, therefore, more litter as SOC source received by soil. No cultivation conducted on the forest has caused the OC of the soil accumulated. Less sunlight, the lower temperature on the soil surface compared to the surrounding area, caused the OM slow to be weathered. Therefore, the OC value of forest was comparable to Zalacca land use. Higher TOC content in this zalacca land use was due to the degradation of cutting leaves as well as grass covering the soil surface among the trees for 15 years. Enough sunlight reaching the soil surface caused the OM to easily degraded and contributed OC to the soil.

The organic carbon content of bush, uncaria, and seasonal crops land was lower than that under forest and zalacca land use. On uncaria land, SOC was primarily derived from the grass growing on the soil surface. This grass could contribute a high OC to soil because it has a short life cycle. Suhadi (2009), explained that soils covered by grass had high OC content because grass has fibrous roots enlarging the rhizosphere area. However, litter from the crop leaves was quite low, because the leaves are harvested to be extracted to get the catechin.

As under uncaria, under bushland use, OC content was also originated from the litter as well as the under-story vegetation. While on seasonal cropland use, high OC than it should be was due to the additional manure added to the soil for each cropping season. Manure is a kind of decomposed OM. Therefore, it can contribute to SOC faster.

Like total OC, the POC content of the soil in each land use at 0-20 cm depth was higher than that at 20-40 cm depth (Figure 1-B). It was because the addition of OC source on the soil surface was faster than that on subsurface soil. On the top 0-20 cm soil depth POC decreased by increasing soil disturbance (forest<zalacca<bush<uncaria<seasonal cropland use). Cultivation causing soil disturbance degrades the POC in the soil; as a consequence, the POC content in the soil also decreased.

Particulate OC decreased by 42%, 39%, 37%, and 3% as the forest was opened and changed into seasonal crop farming, uncaria, bush, and zalacca land use under wet tropical areas, respectively, on the top 0-10 cm soil depth. The small decrease in POC under zalacca land use was probably due to zalacca land use that was never cultivated for the last 15 years, after planting the crop. Then, the leaves cutting, which was put on soil surface among the trees, had contributed to the SOC, especially POC.

The highest decrease in POC under seasonal crops land use was due to intensive cultivation for crop growth. Additional OM, such as manure, did not increase the SOM too much. Guimaraes et al. (2013) found that more than 50% of POM reduced due to cultivation in northeast Brazil.

Unlike on the 0-20 cm, POC on 20-40 cm soil depth under zalacca was 25% higher than that in the forest. At other land use, the POC decreased by 26%, 7%, and 11% as the forest was converted into a bush, uncaria, and seasonal cropland use, respectively. Higher POC on deeper soil depth was seemly affected by the management given to the soil, especially cultivation. Cultivated land had a big chance to move the POC into the deeper soil depth. The lowest content of POC under bushland was probably due to the soil under bushland use was also never open and cultivated for a long time, causing the POC immobile.

If compared to TOC, POC content in wet tropical Ultisols was quite high (Fig. 1-C). It reached 82-88% on the top 0-20 cm and 79-84% on the lower 20-40 cm soil depth. It meant that > 80% of OC in wet tropical areas was in the form of POC. This OC is very sensitive to degradation, such as due to cultivation and other processes of land degradation. Therefore, the cultivation of Ultisols under wet tropical areas will decrease the TOC in a short time.

Particulate OC content linearly correlated to the TOC (Fig 1-D). Amount of POC, 99% (at the top 0-20 cm soil depth), and 96% (at the lower 20-40 cm soil depth) was affected by the content of the TOC. This could be understood that SOC was derived from fresh OC and then degraded into POC before it is totally degraded or mineralized.

As reported by Nurida *et al*. (2007) that the way of OM addition on soil would affect the amount of the POC. Organic matter addition by just accumulated on soil surface would have more POC than that if the OM was added by incorporating it into the soil, such as through cultivation. Gijsman (1996) explained that if OM was not mixed with soil, the POC would be kept from microorganisms attacked.

Soil-OM acculturation will increase soil microorganism access to use POC (53-250 um in size). Therefore, if POC decrease in soil, meaning higher SOM degradation, the amount of N in soil increased. This condition causes lower nutrients stocks in soil aggregates (Nurida *et al*., 2007). In reclaimed coal mining soil, it was shown a strong correlation between SOC and soil's bulk density, pH, total N, and C/N ratio, suggesting an improvement in soil properties (Kumar *et al.,* 2018).

C. Particulate Organic Matter and C/N Ratio

Based on Figure 2(A), there was a tendency of narrowing the gap of POM content of Ultisols under wet tropical areas between the top 20 cm soil with the lower depth (20-40 cm) as increasing tillage intensity given to the soil. It was due to tillage causing the SOM to be degraded faster on the top horizon of the soil.

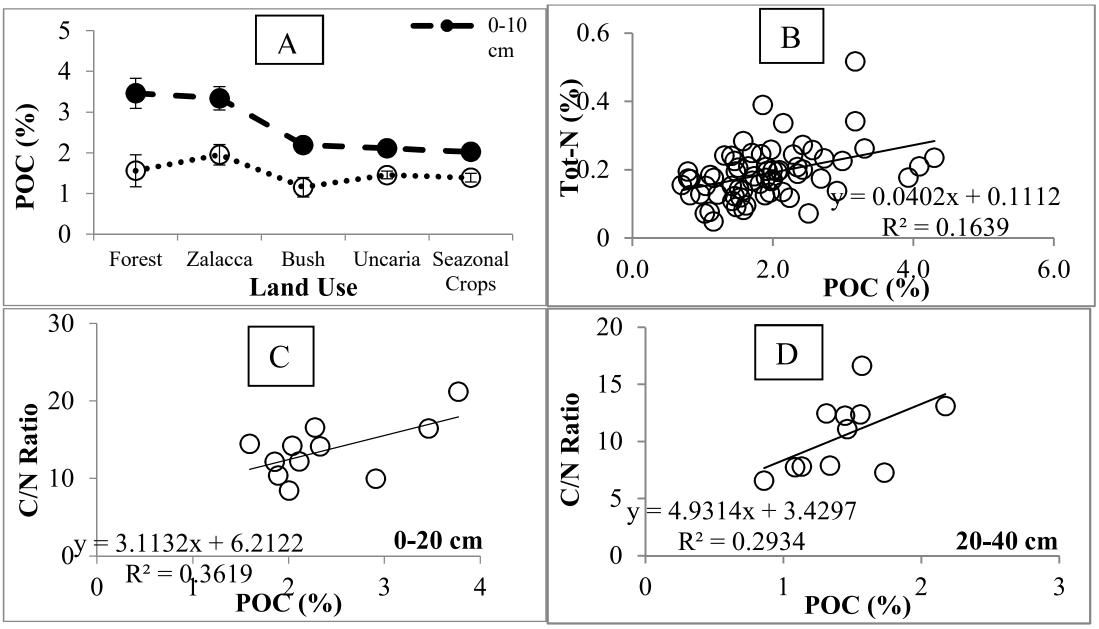

Figure 2. Particulate Organic Carbon (A) and the correlation to Total N (B), and to C/N ratio on 0-20 cm (C) as well as on 20-40 cm soil depth (D).

POC of wet tropical Ultisols did not affect N total value of the soil. Total N of a soil generally affected by the types of SOM sources. Since the soil samples collected from different land use, different types of vegetation, the N content will also be different, while the percentage of C within OM is almost constant.

However, the value of the C/N ratio tended to follow the pattern of POC. It increased by increasing POC content either on the top 20 cm (R2=0.36) or on the 20-

40 cm (R2=0.29) soil depth. It could probably be explained through the fact that POC strongly correlated to TOC (R2=0.99-0.96). At C/N ratio, the value of C used was derived from total organic-C.

CONCLUSION:

Based on the data resulted, it can be concluded that POC of Ultisols under wet tropical area was affected by the management given to the soil (land use type). POC decreased by 42%, 39%, 37%, and 3% as the forest was cleared and changed into seasonal crop farming, uncaria, bush, and zalacca land use, respectively. Generally, the percentage of POC on the top 20 cm was higher than that on the 20-40 cm soil depth. Organic carbon of wet tropical Ultisols was dominated by POM (>80%). The value of POM linearly correlated to TOM either on the top 20 cm (R^2=0.99) or on the 20-40 cm (R^2=0.96) soil depths. The degree of soil disturbance affected the ratio of POM between the top 20 cm and the lower soil depth.

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