Direktorat Riset dan Pengabdian Masyarakat Direktorat Jenderal Riset dan Pengembangan
Kementerian Riset, Teknologi, dan Pendidikan Tinggi
Gedung BPPT II Lantai 19, Jl. MH. Thamrin No. 8 Jakarta Pusat
http://simlitabmas.ristekdikti.go.id/

LAPORAN AKHIR PENELITIAN TAHUN TUNGGAL

ID Proposal: 3f412807-148b-4224-a974-bcc6890f16c8
Laporan Akhir Penelitian: tahun ke-1 dari 1 tahun

1. IDENTITAS PENELITIAN

A. JUDUL PENELITIAN

KAJIAN KLASIFIKASI TANAH DI NAGARI SUNGAI KAMUYANG KECAMATAN LUAK KABUPATEN LIMA PULUH KOTA

B. BIDANG, TEMA, TOPIK, DAN RUMPUN BIDANG ILMU

Bidang Fokus RIRN / Bidang Unggulan Perguruan Tinggi	Tema	Topik (jika ada)	Rumpun Bidang Ilmu
Pangan	Pengembangan sumber daya manusia pertanian	Pengembangan identitas fungsional pertanian	Ilmu Tanah

C. KATEGORI, SKEMA, SBK, TARGET TKT DAN LAMA PENELITIAN

Kategori (Kompetitif Nasional/ Desentralisasi/ Penugasan)	Skema Penelitian	Strata (Dasar/ Terapan/ Pengembangan)	SBK (Dasar, Terapan, Pengembangan)	Target Akhir TKT	Lama Penelitian (Tahun)
Penelitian Kompetitif Nasional	Penelitian Tesis Magister	SBK Riset Dasar	SBK Riset Dasar	3	1

2. IDENTITAS PENGUSUL

Nama, Peran	Perguruan Tinggi/ Institusi	Program Studi/ Bagian	Bidang Tugas	ID Sinta	H-Index
JUNIARTI Ketua Pengusul	Universitas Andalas	Ilmu Tanah		259387	1
Dyah Puspitasari, SP Mahasiswa Bimbingan 1	Universitas Andalas	-	Melakukan klasifikasi tanah di Nagari Sungai Kamuyang Kecamatan Luak Kabupaten Lima Puluh Kota	0	0
Dr. Ir AZWAR RASYIDIN	Universitas Andalas	Ilmu Tanah	Menganalisis klasifikasi tanah di Nagari Sungai	6034122	0

Dosen Pembimbing Anggota 1			Kamuyang Kecamatan Luak Kabupaten Lima Puluh Kota		

3. MITRA KERJASAMA PENELITIAN (JIKA ADA)

Pelaksanaan penelitian dapat melibatkan mitra kerjasama, yaitu mitra kerjasama dalam melaksanakan penelitian, mitra sebagai calon pengguna hasil penelitian, atau mitra investor

Mitra	Nama Mitra

4. LUARAN DAN TARGET CAPAIAN

Luaran Wajib

Tahun Luaran	Jenis Luaran	Status target capaian (*accepted, published, terdaftar atau granted, atau status lainnya*)	Keterangan (*url dan nama jurnal, penerbit, url paten, keterangan sejenis lainnya*)
1	Artikel di Jurnal Internasional Terindeks di Pengindeks Bereputasi	Accepted	Spanish Journal of Soil Science (SJSS)

Luaran Tambahan

Tahun Luaran	Jenis Luaran	Status target capaian (*accepted, published, terdaftar atau granted, atau status lainnya*)	Keterangan (*url dan nama jurnal, penerbit, url paten, keterangan sejenis lainnya*)
1	Paten produk	Terbit nomor pendaftaran paten sederhana	Metoda klasifikasi tanah

5. ANGGARAN

Rencana anggaran biaya penelitian mengacu pada PMK yang berlaku dengan besaran minimum dan maksimum sebagaimana diatur pada buku Panduan Penelitian dan Pengabdian kepada Masyarakat Edisi 12.

Total RAB 1 Tahun Rp. 32,245,000

Tahun 1 Total Rp. 32,245,000

Jenis Pembelanjaan	Item	Satuan	Vol.	Biaya Satuan	Total
Analisis Data	HR Pengolah Data	P (penelitian)	1	1,500,000	1,500,000
Bahan	ATK	Paket	1	1,500,000	1,500,000
Bahan	Barang Persediaan	Unit	1	1,045,000	1,045,000
Bahan	Bahan Penelitian (Habis Pakai)	Unit	6	3,000,000	18,000,000
Pelaporan, Luaran Wajib, dan Luaran Tambahan	Publikasi artikel di Jurnal Internasional	Paket	1	10,000,000	10,000,000
Sewa Peralatan	Peralatan penelitian	Unit	1	200,000	200,000

6. HASIL PENELITIAN

A. RINGKASAN: Tuliskan secara ringkas latar belakang penelitian, tujuan dan tahapan metode penelitian, luaran yang ditargetkan, serta uraian TKT penelitian.

Nagari Sungai Kamuyang terletak di sebelah utara dataran tinggi Gunung Sago sehingga daerah ini tergolong pada fisiografi stratovolkan yang berada pada lereng atas dan tengah dari Gunung Sago. Areal daerah ini berada pada ketinggian 506 – 2.225 meter diatas permukaan laut (m.d.p.l). Geologi di wilayah ini berdasarkan Peta Geologi Lembar Solok (0815) memiliki dua jenis batuan induk yaitu Qamg dan Qpt2. Bahan induk Qamg merupakan hasil-hasil dari batuan Andesit Gunung Malintang sedangkan Qpt2 merupakan hasil dari Tuf Batuapung dan Andesit (Basal). Batuan induk ini akan memberi pengaruh besar terhadap jenis dan sifat tanah. Nagari Sungai Kamuyang memiliki jenis tanah dengan greatgroup Hydrandepts dan Dystrandepts, berdasarkan Peta Satuan Lahan dan Lembar Solok (0815) yang dikeluarkan oleh Pusat Penelitian Tanah dan Agroklimat pada tahun 1990,. Berdasarkan Sistem Klasifikasi Tanah tahun 1975, Dystrandepts dan Hydrandepts pada sistem klasifikasi 7th Approxionation merupakan great group dari tanah Andept sebagai sub ordo Inceptisol. Nama subordo Andept ini, oleh Smith digunakan dalam klasifikasi Soil Taxonomy A Basic System of Soil Classification for Making and Interpreting Soil Surveys pada tahun 1978 dan resmi dipakai di dalam Soil Taxonomy pada tahun 1990 hingga sekarang sebagai satu ordo baru, yaitu Andisol. Namun berdasarkan penelitian Sari (2018), dari hasil pengamatan tanah yang telah dilakukan di Nagari Sungai Kamuyang tidak ditemukan penciri khusus Andisol (epipedon melanik) pada lapisan tanah hingga kedalaman 60 cm. Selain itu dari hasil analisis sifat tanah juga tidak ditemukan ciri khusus sifat tanah Andik, dimana ditemukan kandungan fosfat tersedia yang sangat tinggi dengan nilai mencapai 39 ppm. Hal ini berbanding terbalik dengan pernyataan Tan (1991) yaitu Andisol merupakan tanah yang memiliki kadar fosfat tersedia yang rendah akibat jerapan fosfat yang tinggi hingga 90% oleh mineral liat Al dan alofan. Oleh karena itu, untuk mendapatkan informasi yang akurat maka diperlukan kembali kajian klasifikasi tanah di Nagari Sungai Kamuyang. Berdasarkan uraian di atas, maka peneliti tertarik untuk melakukan penelitian tentang “ Kajian Klasifikasi Tanah di Nagari Sungai Kamuyang Kecamatan Luak Kabupaten Lima Puluh Kota”. Tujuan dari penelitian ini adalah untuk mengkaji klasifikasi tanah di Nagari Sungai Kamuyang Kecamatan Luak Kabupaten Lima Puluh Kota berdasarkan Soil Taxonomy USDA oleh Soil Survey Staff (2014) sampai tingkat family dan disetarakan dengan Klasifikasi Tanah Nasional (KTN) 2014 hingga tingkat macam tanah dan memperoleh informasi mengenai klasifikasi tanah di Nagari Sungai Kamuyang yang akan disajikan dalam bentuk peta dengan skala 1 : 50.000. Tahapan metoda penelitian dilakukan dengan menggunakan metode survei pada tingkat semi detil dengan skala peta 1:50.000. Berdasarkan hasil penelitian mengenai kajian klasifikasi tanah pada Nagari Sungai Kamuyang, Kecamatan Luak, Kabupaten Lima Puluh Kota, ditemukan perbedaan hasil klasifkasi tanah di Nagari Sungai Kamuyang yang disajikan oleh Peta Satuan Lahan Lembar Solok oleh Pusat Penelitian Tanah dan Agroklimat tahun 1990, dimana hanya pada profil SL3 yang menunjukkan ciri tanah Andisol sedangkan pada profil lainnya menunjukkan ciri tanah Inceptisol. Hasil klasifikasi tanah berdasarkan Sistem Taksonomi Tanah (Soil Survei Staff, 2014) pada profil SL1, SL2, SL4, SL5, SL6, dan SL7 diklasifikasikan sebagai Ordo: Inceptisols, Sub Ordo: Udepts, Great Group: Dystrudepts, Sub Group: Andic Dystrudepts, Family: Berdebu Halus, Kaolinit, Isohypertermik, Andic Dystrudepsts. Pada profil SL3 diklasifikasikan sebagai Ordo: Andisols, Sub Ordo: Udands, Great Group: Hapludands, Sub Group: Typic Hapludands, Family: Medial, Amorfik, Isohypertermik, Typic Hapludands. Untuk Klasifikasi Tanah Nasional (2014) profil SL1, Sl2, SL4, SL5, SL6, dan SL7 diklasifikasikan sebagai Jenis: Latosol, Macam: Latosol Umbrik. Profil SL3 diklasifikasikan sebagai Jenis: Andosol, Macam: Andosol Distrik. Dari hasil penelitian yang telah dilakukan diperoleh luaran berupa artikel yang sudah di publish dalam jurnal Nasional terakreditasi (Sinta 4) yaitu Jurnal Tanah dan Sumberdaya Lahan, juga publikasi pada International Conference on Agricultural and Life Scince (ICALS) 2020 dengan prosiding IOP terindeks scopus serta artikel sudah disubmit dalam proses review pada jurnal internasional yaitu Jurnal Soil Science and Plant Nutrition (Q2). Draft paten produk (peta tanah nagari Sungai Kamuyang Kecamatan Luak Kab. Lima Puluh Kota skala 1:50.000). Sehingga akan diperoleh informasi yang tepat untuk klasifikasi tanah dan teknologi pengelolaan tanah yang sesuai dengan karakteristik tanah yang sudah diklasifikasikan sampai tingkat macam tanah. Dengan demikian Tingkat

Kesiapan Teknologi penelitian dapat dicapai pada akhir tahun pada level 3.

B. KATA KUNCI: Tuliskan maksimal 5 kata kunci.

Andisol ; Klasifikasi Tanah; Nagari Sungai Kamuyang

Pengisian poin C sampai dengan poin H mengikuti template berikut dan tidak dibatasi jumlah kata atau halaman namun disarankan seringkas mungkin. Dilarang menghapus/memodifikasi template ataupun menghapus penjelasan di setiap poin.

C. HASIL PELAKSANAAN PENELITIAN: Tuliskan secara ringkas hasil pelaksanaan penelitian yang telah dicapai sesuai tahun pelaksanaan penelitian. Penyajian dapat berupa data, hasil analisis, dan capaian luaran (wajib dan atau tambahan). Seluruh hasil atau capaian yang dilaporkan harus berkaitan dengan tahapan pelaksanaan penelitian sebagaimana direncanakan pada proposal. Penyajian data dapat berupa gambar, tabel, grafik, dan sejenisnya, serta analisis didukung dengan sumber pustaka primer yang relevan dan terkini.

Pengisian poin C sampai dengan poin H mengikuti template berikut dan tidak dibatasi jumlah kata atau halaman namun disarankan seringkas mungkin. Dilarang menghapus/memodifikasi template ataupun menghapus penjelasan di setiap poin.

C. **HASIL PELAKSANAAN PENELITIAN:** Tuliskan secara ringkas hasil pelaksanaan penelitian yang telah dicapai sesuai tahun pelaksanaan penelitian. Penyajian dapat berupa data, hasil analisis, dan capaian luaran (wajib dan atau tambahan). Seluruh hasil atau capaian yang dilaporkan harus berkaitan dengan tahapan pelaksanaan penelitian sebagaimana direncanakan pada proposal. Penyajian data dapat berupa gambar, tabel, grafik, dan sejenisnya, serta analisis didukung dengan sumber pustaka primer yang relevan dan terkini.

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Kamuyang Kecamatan Luak Kab. Lima Puluh Kota skala 1:50.000). Sehingga akan diperoleh informasi yang tepat untuk klasifikasi tanah dan teknologi pengelolaan tanah yang sesuai dengan karakteristik tanah yang sudah diklasifikasikan sampai tingkat macam tanah. Dengan demikian Tingkat Kesiapan Teknologi penelitian dapat dicapai pada akhir tahun 2020 pada level 3.

D. **STATUS LUARAN**: Tuliskan jenis, identitas dan status ketercapaian setiap luaran wajib dan luaran tambahan (jika ada) yang dijanjikan pada tahun pelaksanaan penelitian. Jenis luaran dapat berupa publikasi, perolehan kekayaan intelektual, hasil pengujian atau luaran lainnya yang telah dijanjikan pada proposal. Uraian status luaran harus didukung dengan bukti kemajuan ketercapaian luaran sesuai dengan luaran yang dijanjikan. Lengkapi isian jenis luaran yang dijanjikan serta mengunggah bukti dokumen ketercapaian luaran wajib dan luaran tambahan melalui Simlitabmas mengikuti format sebagaimana terlihat pada bagian isian luaran

Luaran wajib berupa publikasi pada jurnal Internasional terindeks scopus sudah di submit dan dalam proses review "Jurnal Soil Science and Plant Nutrition (Q2)"., juga luaran berupa publikasi pada jurnal nasional terakreditasi Sinta 4 sudah publish. Seminar Internasional online sudah diseminarkan pada tanggal 6-7 bulan Oktober 2020 "The 4th International Conference on Agriculture and Life Science" (sudah ada sertifikat international conference). Bukti penerimaan LOA seminar dan sertifikat telah diunggah melalui Simlitabmas. Luara tambahan dalam bentuk paten sederhana masih dalam draft yaitu Peta tanah Nagari Sungai Kamuyang Kecamatan Luak Kabupaten Lima Puluh Kota skala 1:50.000.

E. **PERAN MITRA:** Tuliskan realisasi kerjasama dan kontribusi Mitra baik *in-kind* maupun *in-cash* (jika ada). Bukti pendukung realisasi kerjasama dan realisasi kontribusi mitra dilaporkan sesuai dengan kondisi yang sebenarnya. Bukti dokumen realisasi kerjasama dengan Mitra diunggah melalui Simlitabmas mengikuti format sebagaimana terlihat pada bagian isian mitra

Pemerintah Daerah Nagari Sungai Kamuyang Kecamatan Luak Kabupaten Lima Puluh Kota sangat berperan dan memberikan kontribusi nyata terutama pada saat di lapangan, kontribusi tersebut dalam bentuk in kind dengan mempermudah pelaksanaan penelitian yang dilakukan.

F. **KENDALA PELAKSANAAN PENELITIAN**: Tuliskan kesulitan atau hambatan yang dihadapi selama melakukan penelitian dan mencapai luaran yang dijanjikan, termasuk penjelasan jika pelaksanaan penelitian dan luaran penelitian tidak sesuai dengan yang direncanakan atau dijanjikan.

Tidak ada kendala berarti yang dihadapi selama pelaksanaan penelitian sehingga luaran wajib berupa publikasi pada jurnal Internasional terindeks Scopus sudah di submit dan dalam proses review, bukti submit dan dalam proses review telah diunggah melalui Simlitabmas.

G. RENCANA TINDAK LANJUT PENELITIAN: Tuliskan dan uraikan rencana tindaklanjut penelitian selanjutnya dengan melihat hasil penelitian yang telah diperoleh. Jika ada target yang belum diselesaikan pada akhir tahun pelaksanaan penelitian, pada bagian ini dapat dituliskan rencana penyelesaian target yang belum tercapai tersebut.

Rencana tahapan selanjutnya menunggu accepted publikasi pada jurnal Internasional terindeks Scopus "Jurnal Soil Science and Plant Nutrition (Q2)" .

H. DAFTAR PUSTAKA: Penyusunan Daftar Pustaka berdasarkan sistem nomor sesuai dengan urutan pengutipan. Hanya pustaka yang disitasi pada laporan akhir yang dicantumkan dalam Daftar Pustaka.

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4. Buckman dan N. C. Brady. 1982. *Ilmu Tanah*. Bhatara Karya Aksara. Jakarta. 788 hal.
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Abstract:	This study was aimed to examine the classification of soil in Sungai Kamuyang, West Sumatra, Indonesia by the USDA Soil Taxonomy up to the level of family. This research was conducted in Sungai Kamuyang, Luak District, Limapuluh Kota Regency, West Sumatra-Indonesia, Laboratory of Soil Science Andalas University, and Laboratory of Soil Chemistry and Laboratory of Soil Mineralogy of Soil Research Center, Bogor. This research used a surveiy method with several stages: Preparation, Pre-Survey, Main Survey, Soil Analysis, and Data Processing. Based on the results on the research of soil classification in Sungai Kamuyang, found differences in the results in classification of Soil in Sungai Kamuyang served Land Unit Map Sheet Solok by Soil and Agroclimate Research Center in 1990, which is only on the profile SL3 showing characteristics of Andisols while on the other profiles show Inceptisols chararacteristics. The results of soil classification based on the USDA Soil Taxonomy System, on SL1, SL2, SL4, SL5, SL6, and SL7 profiles were classified into Ordo: Inceptisols, Sub Ordo: Udepts, Greatgroup: Dystrudepts, Sub Group: Andic Dystrudepts, Family: Fine silt, Kaolinit, Isohypertemic, Andic Dystrudepts. SL3 profiles was classified into Ordo: Andisols, Sub Ordo: Udands, Great Group: Hapludands, Family: Medial, Amorphic, Isohypertermic, Typic Hapludands.
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Properties and Reclassification of Volcanis Soil In Sungai Kamuyang, West Sumatra, Indonesia

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Abstract
This study was aimed to examine the classification of soil in Sungai Kamuyang, West Sumatra, Indonesia by the USDA Soil Taxonomy up to the level of family. This research was conducted in Sungai Kamuyang, Luak District, Limapuluh Kota Regency, West Sumatra-Indonesia, Laboratory of Soil Science Andalas University, and Laboratory of Soil Chemistry and Laboratory of Soil Mineralogy of Soil Research Center, Bogor. This research used a surveiy method with several stages: Preparation, Pre-Survey, Main Survey, Soil Analysis, and Data Processing. Based on the results on the research of soil classification in Sungai Kamuyang, found differences in the results in classification of Soil in Sungai Kamuyang served Land Unit Map Sheet Solok by Soil and Agroclimate Research Center in 1990, which is only on the profile SL3 showing characteristics of Andisols while on the other profiles show Inceptisols chararacteristics. The results of soil classification based on the USDA Soil Taxonomy System, on SL1, SL2, SL4, SL5, SL6, and SL7 profiles were classified into Ordo: Inceptisols, Sub Ordo: Udepts, Greatgroup: Dystrudepts, Sub Group: Andic Dystrudepts, Family: Fine silt, Kaolinit, Isohypertemic, Andic Dystrudepts. SL3 profiles was classified into Ordo: Andisols, Sub Ordo: Udands, Great Group: Hapludands, Family: Medial, Amorphic, Isohypertermic, Typic Hapludands.
Keywords: *Soil classification, USDA soil taxonomy system, Sungai Kamuyang..*

Introduction

Nagari Sungai Kamuyang, West Sumatra is located in the north of Mount Sago so that this area was classified as stratovolkan physiography. The area is located at an altitude of 506 – 2.225 meters above sea lecel. The geology in this region based on the Solok Sheet Geological Map (0815) has two types of parent material. Qamg parent material is the product of Mount Malintang Andesite rocks, Qpt2 is the result of Tuff pumice and andesite basalt. This parent material will give a big influence on the soil properties.

Based on the Land Unit Map Solok Sheet (1085) scale of 1 : 250.000 by Soil and Agroclimate Research Center in 1990, the soil type in Nagari Sungai Kamuyang was classified into greatfroup Hydrandepts and Dystrandepts. Based on the Soil Classification System in 1975, Dystrandepts and Hydrandepts in the 7th Approxination Classifisication Systems are a greatgroup of Andept as a subordo of Inceptisols. By Smith, this Andept Subordo was used in the Classification of Soil Taxonomy A Basic System of Soil Classification for Making and Interpreting Soil Surveys in 1978 and officially used in the Soil Taxonomy in 1990 and now as a new Ordo, namely Andisols.

Andisols are soils formed from volcanic ash, pumice, and/or other volcanic eruptions, which have ≥60% of Andic soil charactersitics to a depth of 60 cm. This soil has an exchange complex dominated by amorphous compound of Al, Si, and/or Fe, and humus. This soil was composed of sand fraction's minerals in the form of quartz, plagioclase, hornblende augite, hypersteine, olivine, and volcanic glass. The clay minerals are dominated by non-crystalline clay minerals consistine of allophane, imogolite, and/or ferritic acid in addition to halloysite, gibsite, and cristobalite, has bulk density ≤ 0,90 g/cm^3, phosphate retention ≥85%. Epipedon identified of this soil, among others melanic, umbric, or ochric and have cambic horizon on the bottom layer (Smith, 1978; Parfitt and Childs, 1988).

However, based on Sari (2018), there is no specific characteristics of Andisols on the soil layer to a depth of 60 cm. In addition, from the results of soil properties analysis, which found the available phosphorus content was very high with a value of 39 ppm. This is inversely proportional to the statement of Tan (1984) that Andisols is a soil that has a low level of available phosphorus due to high phosphate sorption up to 90% by Al and allophane clay minerals.

The incompatibility of soil types information on the Nagari Sungai Kamuyang based on Solok Sheet Land Unit Map issued by the Soil and Agroclimatology Research Center in 1990 with the results of research conducted by Sari (2018) allegedly caused by maps issued as source data was small scale maps 1 : 250.000. According to Burrough (1986), map scale is a measure of the detail of data in conventional mapping system. Soil data presented in the form of maps will be related to scale. In addition, maps with a scale of 1 : 250.000 are known as derivative maps, which are maps that were not made directly from stereoplatting or surveys but were made using maps that already existed as a source on a larger scale. This affects the appearance of points, lines, and areas that result in changes in the amount of length and area (Hisanah *et al*., 2015). Therefore, to get more accurate and detailed information, a soil classification study in Nagari Sungai Kamuyang is needed. Based on the above, a study was conducted on "Soil Classification in Nagari Sungai Kamuyang, West Sumatra, Indonesia.

Material and Methods

The research was conducted in Nagari Sungai Kamuyang, Luak District, Limapuluh Kota Regency, West Sumatra, Indonesia. The soil analysis conducted in Soil Science Laboratory of Agriculture Faculty of Andalas University and Soil Chemistry Laboratory of Soil Research Center in Bogor. The main tools used in this study are maps, climate data research area (rainfall, temperature, and soil temperature), GPS, Abney level, drill of soil mineral, ring samples, Munsell Soil Colour Charts, knive, soil profile description cards, stationery, and laboratory equipment. The materials used are labels, rubber bands, plastic bags, and chemicals needed for soil analysis in the laboratory.

The method used in this study is a semi-detailed survey method with a map scale of 1 : 50.000. Sampling was done by Purpossive Random Sampling based on land units with an area of more than 25 hectares. The stages of this research consisted of: preparation, pre-survey, main survey, laboratory analysis, and data processing. Data obtained in the field and in the laboratory are used as a basis for determining soil classification according to the USDA Soil Taxonomy System by Soil Survei Staff (2014) from Ordo to Family level. Observation of soil characteristics in the field is done through observing the soil profile. Soil profile is done on each land units with a size of 1,5 m (length) x 1.5 m (width) x 1.5 m (height). Soil sampling is done in two ways, namely satellite soil sampling and undisturbed soil sampling. Satellite soil samples are taken from each horizon A and B in the soil profile. Undisturbed soil samples is carried out using the ring samples on horizon A and B. The physichal characteristics of land observed in this study are slope, erosion, drainage, and surface rocks. Soil properties analyzed in this study were soil texture, base saturation, pH (H_2O, KCl, and NaF), C-Organic and organic matter, base cations (Ca, Mg, K, and Na), melanic index, and Al, Fe, and Si Oxalate extract.

Results

Soil Morphology Characteristics

Figure 1. 1st Soil Profiles

Figure 2. 2nd Soil Profiles

Figure 3. 3rd Soil Profiles

Figure 4. 4th Soil Profiles

Figure 5. 5th Soil Profiles

Figure 6. 6th Soil Profiles

Figure 7. 7th Soil Profiles

Soil Physical Characteristics

Table 1. Soil Bulk density and Texture in Nagari Sungai Kamuyang

Profile	Horizon	Depth (cm)	Texture				Bulk density (g/cm^3)
			% Sand	% Silt	% Clay	Class	
1	A	0 – 14	21,95	59,33	18,72	Silty loam	0,82
	B1	14 – 70	8,75	12,15	79,1	Clay	0,77
	B2	70 – 130	20,21	16,48	63,31	Clay	
2	A0	0 – 10	20,81	16,46	62,73	Clay	0,88
	A1	10 – 30	17,35	50,2	32,45	Clay	
	A2	30 – 62	41,12	8.81	50,07	Clay	
	B1	62 – 89	26,08	17,71	56,21	Clay	0,82
	B2	89 – 100	43,27	10,61	46,12	Clay	
3	A0	0 – 2	17,07	3,18	79,75	Clay	0,69
	A	2 – 18	20,18	6,64	73,18	Clay	
	B1	18 – 48	13,62	12,31	74,07	Clay	0,59
	B2	48 – 79	17,78	10,25	71,97	Clay	
	B3	79 – 100	15,55	10,88	73,57	Clay	
4	A	0 – 39	20,42	30,24	49,34	Clay	0,72
	B	39 – 110	23,86	35,07	41,07	Clay	0,88
5	A0	0 – 9,5	28,91	7,88	63,21	Clay	0,83
	A1	9,5 – 30	9,86	46,65	43,49	Silty clay	
6	A	0 – 10	35,37	15,35	49,28	Clay	0,87
	A1	10 – 26	37,09	17,11	45,8	Clay	
	B1	26 – 40	40,73	2,57	56,7	Clay	0,74
	B2	40 – 67	18,8	19,44	61,76	Clay	
	B3	67 – 100	75,03	3,1	21,87	Sandy clay loam	
7	A	0 – 30	9,84	9	81,6	Clay	0,84
	B1	30 – 50	9,86	18	72,14	Clay	0,79
	B2	50 – 100	9,88	31,46	58,66	Clay	

Soil Chemical Characteristics

Soil Reaction (pH)

Table 2. Soil Reaction in Nagari Sungai Kamuyang

Profile	Horizon	Depth (cm)	pH		Delta pH	pH NaF	
			H_2O	KCl		1 minute	60 minute
1	A	0 – 14	4,65	4,16	-0,49	9,61	10,29
	B1	14 – 70	4,84	3,92	-0,92	9,9	10,58
	B2	70 – 130	4,79	4	-0,79	10,09	10,76
2	A0	0 – 10	5,67	5,02	-0,65	10	11,2
	A1	10 – 30	5,23	4,48	-0,75	10,43	10,76
	A2	30 – 62	5,09	4,32	-0,77	10,08	10,81
	B1	62 – 89	5,19	4,4	-0,79	10,37	11,08
	B2	89 – 100	5,16	4,4	-0,76	10,38	11,1
3	A0	0 – 2	4,56	4,18	-0,38	10,17	10,85
	A1	2 – 18	4,62	4,16	-0,46	10,73	11,34
	B1	18 – 48	4,98	4,53	-0,45	11,35	11,71
	B2	48 – 79	5,07	5,09	-0,02	11,49	11,76
	B3	79 – 100	4,98	4,2	-0,78	10,79	11,38
4	A	0 – 39	6,75	6,02	-0,73	9,7	10,14
	B	39 – 110	6,37	5,07	-1,3	10,68	11,21
5	A0	0 – 9,5	6,09	4,87	-1,22	8,7	8,97
	A1	9,5 – 30	6,49	5,52	-0,97	8,91	9,25
6	A	0 – 10	5,33	4,36	-0,97	8,69	9,05
	A1	10 – 26	6,01	4,96	-1,05	9,27	9,73
	B1	26 – 40	5,75	4,85	-0,9	9,46	9,96
	B2	40 – 67	6,05	5,15	-0,9	8,81	9,18
	B3	67 – 100	6,02	5,05	-0,97	8,99	9,33
7	A	0 – 30	4,75	4,17	-0,58	9,57	10,06
	B1	30 – 50	4,96	4,16	-0,8	10,27	10,81
	B2	50 – 100	5,15	4,17	-0,98	10,22	10,9

Soil Organic Matter

Table 3. C-organic content and Soil Organic Matter in Nagari Sungai Kamuyang

Profile	Horizon	Depth (cm)	% C-organik	% Organic Matter
1	A	0 – 14	3,23	5,55
	B1	14 – 70	2,87	4,93
	B2	70 – 130	2,83	4,86
2	A0	0 – 10	3,1	5,33
	A1	10 – 30	3,05	5,24
	A2	30 – 62	3,05	5,24
	B1	62 – 89	2,93	5,03
	B2	89 – 100	3	5,16
3	A0	0 – 2	3,03	5,21
	A1	2 – 18	3,03	5,21
	B1	18 – 48	3,12	5,36
	B2	48 – 79	3,1	5,33
	B3	79 – 100	2,9	4,98
4	A	0 – 39	3,25	5,59
	B	39 – 110	2,9	4,98
5	A0	0 – 9,5	3,05	5,24
	A1	9,5 – 30	2,85	4,990
6	A	0 – 10	2,87	4,93
	A1	10 – 26	2,82	4,85
	B1	26 – 40	2,72	4,67
	B2	40 – 67	3	5,16
	B3	67 – 100	2,82	4,85
7	A	0 – 30	3,15	5,41
	B1	30 – 50	3,12	5,36
	B2	50 – 100	3,05	5,24

Base Cations and Base Saturation

Table 4. Base Cations and Base Saturation in Nagari Sungai Kamuyang

Profile	Horizon	Depth (cm)	Base Cations (me/100 g)				Base Saturation (%)
			Ca	Mg	K	Na	
1	A	0 – 14	1,99	1,95	0,68	0,53	21,69
	B1	14 – 70	3,32	1,65	0,64	0,71	35,68
	B2	70 – 130	1,96	1,88	0,7	0,5	23,35
2	A0	0 – 10	2,38	1,68	0,77	0,58	28,14
	A1	10 – 30	2	1,55	0,68	0,62	23,11
	A2	30 – 62	2,46	1,45	0,72	0,67	28,02
	B1	62 – 89	2,47	1,58	0,59	0,67	26,85
	B2	89 – 100	2,87	1,25	0,71	0,69	26,90
3	A0	0 – 2	2,66	1,44	0,86	0,84	29,95
	A1	2 – 18	2,32	1,83	0,68	0,74	26,31
	B1	18 – 48	2,99	1,79	0,66	0,82	34,07
	B2	48 – 79	2,27	1,58	0,73	0,84	33,89
	B3	79 – 100	2,51	1,48	0,61	0,85	18,42
4	A	0 – 39	3,36	1,81	0,6	0,9	22,70
	B	39 – 110	2,01	1,85	0,68	0,76	20,76
5	A0	0 – 9,5	2,36	1,85	0,79	0,7	22,68
	A1	9,5 – 30	4,51	1,9	0,92	0,84	70,98
6	A	0 – 10	3,08	1,74	0,86	0,89	20,69
	A1	10 – 26	3,9	1,62	0,63	0,65	38,09
	B1	26 – 40	3,14	1,74	0,67	0,58	28,93
	B2	40 – 67	3,24	1,62	0,84	0,59	16,80
	B3	67 – 100	3,15	1,67	0,83	0,46	23,71
7	A	0 – 30	3,62	1,8	0,82	0,77	20,91
	B1	30 – 50	3,9	1,89	0,73	0,71	27,28
	B2	50 – 100	4,44	1,94	0,76	0,85	27,06

Phosphate Retention and Al, Fe, Si, Oxalate Extract Content

Table 5. Phosphate retention and Al, Fe, Si Oxalate Extract Content in Nagari Sungai Kamuyang

Profile	Horizon	Depth (cm)	Oxalate Extract (%)			Al_o+ ½ Fe_o	Phosphate retention (%)
			Al	Fe	Si		
1	A	0 – 14	0,73	1,02	0,14	1,24	61,14
	B1	14 – 70	0,58	0,88	0,24	1,02	66,1
	B2	70 – 130	0,5	0,41	0,14	0,705	57,8
2	A0	0 – 10	1,03	1,76	0,21	1,91	78,5
	A1	10 – 30	1,15	1,91	0,28	2,105	82,1
	A2	30 – 62	0,79	1,42	0,29	1,5	77,9
	B1	62 – 89	0,73	1,98	0,26	1,72	77,7
	B2	89 – 100	0,73	2,02	0,24	1,74	84,6
3	A0	0 – 2	1,38	2,67	0,26	2,715	87,6
	A1	2 – 18	1,48	2,96	0,3	2,96	82,1
	B1	18 – 48	1,91	3,54	0,38	3,68	94,3
	B2	48 – 79	2,38	3,89	0,52	4,325	97,5
	B3	79 – 100	0,9	1,79	0,29	1,795	83,1
4	A	0 – 39	0,89	2,61	0,32	2,195	58,9
	B	39 – 110	1,1	2,18	0,34	2,19	77
5	A0	0 – 9,5	0,26	2,59	0,27	1,555	35,5
	A1	9,5 – 30	0,26	3,26	0,26	1,89	35,5
6	A	0 – 10	0,34	3,98	0,26	2,33	53,8
	A1	10 – 26	0,4	3,49	0,22	2,145	51,3
	B1	26 – 40	0,45	4,02	0,25	2,46	52,6
	B2	40 – 67	0,29	5,8	0,32	3,19	58,3
	B3	67 – 100	0,46	9,1	0,26	5,01	60,6
7	A	0 – 30	0,63	1,45	0,21	1,355	63,3
	B1	30 – 50	0,65	0,86	0,24	1,08	69
	B2	50 – 100	0,59	0,75	0,3	0,965	68

Melanic Index

Table 6. Soil melanic index in Nagari Sungai Kamuyang

Profile	Horizon	Depth (cm)	Melanic index
1	A	0 – 14	1,76
	B1	14 – 70	1,5
	B2	70 – 130	0,75
2	A0	0 – 10	1,92
	A1	10 – 30	1,65
	A2	30 – 62	1,89
	B1	62 – 89	1
	B2	89 – 100	2
3	A0	0 – 2	1,88
	A1	2 – 18	1,86
	B1	18 – 48	1,87
	B2	48 – 79	1,77
	B3	79 – 100	1,6
4	A	0 – 39	1,76
	B	39 – 110	1
5	A0	0 – 9,5	2
	A1	9,5 – 30	1,33
6	A	0 – 10	2
	A1	10 – 26	1,56
	B1	26 – 40	1,76
	B2	40 – 67	1,39
	B3	67 – 100	1,15
7	A	0 – 30	1,68
	B1	30 – 50	1,5
	B2	50 – 100	1,5

Discussions

Climate research area

Based on the Schmidth Fergusson Climate Classification Systems, during the 10 year observation period, Nagari Sungai Kamuyang was classified as type B climate (wet; 14,3% < Q < 33,3%) with a Q value of 24,8%. The pattern of rainfall from the average rainfall for 10 years (observation period 2008 – 2017) shows that in Nagari Sungai Kamuyang have two peaks of rainfall in April with an average rainfall of 242,6 mm/month and November with an average rainfall of 350,7 mm/month. There were no dry month because the lowest rainfall was 91,6 mm. The humid month occur in June and July with rainfall ranging between 91,6 to 92,9 mm/month. The wet month occur in January, February, March, April, May, August, September, October, November, and December with rainfall ranging from 131,2 to 350,7 mm.month.

Soil moisture regime can be determined by looking at the pattern of the rainfall in the research area. Based on existing rainfall data, note that the rainfall in research area is distributed troughout the year so that the soil does not dry for 90 days cumulative throughout the year. Based on this, the soil moisture regime at the research area is Udic.

Temperatures in Nagari Sungai Kamuyang are in the range of values from 12,95 ^oC to 23,26 ^oC. The soil temperature at the research area was obtained from the formula of Van Wambeke (1982) by adding an air temperature of 2,5 ^oC. It is based on reserach Van Wambeke (1981) which is the average in the United States by an additional 1 ^oC to 2 ^oC temperature of the soil and elsewhere. Whereas in the tropics there was an increase in the soil temperature of 2,5 ^oC from the air temperature, so that the soil temperature obtained at the research area was 22,6 – 25,57 ^oC. From the soil temperature value, the soil temperature regime at the research area is isohypertermic with a soil temperature > 22 ^oC with an average temperature difference in the summer and winter less than 6 ^oC. The difference in soil temperature less than 6 ^oC is supported by the statement of Hadi (2010) that changes in soil surface temperature in Indonesia in the period 1979 – 2009 in the rainy and dry season ranged from 0,5 to 1,5 ^oC. In addition, Fajrin and Driptufany (2017) stated that changes in the soil surface temperature in West Sumatra during the period 2007 – 2013 were recorded at a maximum of 4 ^oC.

Soil Morphology Characteristics

Of the seven soil profiles observed, each has a different morphology. In 5th profile, it was found horizons that were already dominated by rocks called C or B/C horizons at a depth of 30 cm. However, on 1st, 2nd, 3rd, 4th, 6th, and 7th profiles, horizon B was found in deeper solum with an average depth more than 100 cm.

The soil color on each profile tends to be darker (brown to black) with Hue 7,5 YR and 10 YR on 1st, 2nd, 3rd, 4th, and 7th profiles with varying values and chroma of 2/2 to 5/6, while the 5th and 6th soil profiles has a color with a 7,5 Y Hue with a value of values and chroma 2/2 to 6/1. The color of the soil will affect other soil properties through radiation from sunlight energy. The heat energy contained in the darker soil will result in higher evaporation rates so that the darker soil will dry out faster than lighter colored soils (Hillel, 1982). The color of the soil can indicate organic matter in the soil because organic matter gives a dark or blackish color. According to Hakim (1986), the higher content of soil organic matter the darker color of the soil. In addition, the color of the soil can be used to determine the level of weathering. The reddish soil color indicates the level of weathering is getting further.

Soil structure was also observed in observing soil profiles. The soil structure in each soil is dominated by granular structure and angular with a moderate level of development. Soil structure affects the movement of water in the soil. Crumb structure will have more porous space than angular structure so that water will enter the soil more quickly (Foth, 1999).

Soil Physical Characteristics

Bulk Density

Based on the results, that the average of the soil bulk density is < 1 g/cm^3 is equal to 0,59 to 0,88 g/cm^3. The low bulk density can be caused due to an amorphous mineral content in the soil so that number of micropores is quite a lot, especially intra and inter particle pore space. Higher bulk density will affect the pore spaces of the soil, the lower bulk density will be higher pore space (Juarti, 2016). Low soil bulk density due to allophane contributes to the development of pores in the soil structure. The pore arrangement of allophane structure unit causes allophane porosity to be high (Wada, 1985). Shoji *et al* (1993) stated that allophane has a perforated structure and with a diameter of 3 – 4 mm. The heavy of soil bulk density will be lower along with the increase in allophane content because of 25 – 45% of the pore volume of Andisol is occupied by allophane.

Soil Texture

All soil profiles have a very high clay fraction with a range of 18,72 – 81,6 %, with the highest clay fractions found in the 7th profile and the lowest clay fraction found in the 1st profile. The high clay fraction in each profile shows that the soil has undergone further weathering. Most of the soil has more clay content in horizon B compared to horizon A. The older the soil, the difference in clay content between horizon A and B will be even greater. The content of each fraction (sand, silt, and clay) in each soil horizon is influenced by three things, the movement of clay from horizon A to horizon B duet o percolation water, chemical weathering from clay in horizon A and leaching duet o drainage water, and weathering silt and sand so as to form clay on the horizon B (Thompson, 1957).

Soil Chemical Characteristics

Soil Reaction (pH)

Based on the results, pH values ranged from 4,56 to 6,75. The diversity of soil pH values is caused by weathering that occurs. In the weathering process, when base cations (Ca, Mg, K, and Na) are detached from spcace between the micelles then the pH will increase, whereas if the loose cations of Al, Fe, and Si then the pH will tend to decrease (Fiantis, 2006). In soils with moderate acidity, aluminium and hydrogen compunds cause hydrogen ions to dissolve in the soil. Al-hydroxide ions adsorbed and transformed into exchangable cations. In the soil solution, Al-hydroxide will produce H ions due to Al hydrolysis reaction (Buckman and Brady, 1982). The pH delta values obtained to negative value, this indicates that many colloidal soils have negative charges so that it has ability to bind positively charged base cations (Fiantis, 2006). The pH values will determine the amount of positive and negative charges on the surface of the colloid. If the delta pH value of ± 0,5 indicates that the soil is variable, that is the charge changes according to the increase and decrease of soil pH (Arifin, 1994). Increase and decrease of soil pH is influenced by the input given to the soil, either in the form of inorganic and organic fertilizers or various types of ameliorant material such as phosphate rock or volcanic ash. The value of NaF pH obtained in each soil ranged from 8,7 to 11,49. The high pH of NaF in this soil indicates that the soil is contains high amorphous material which dominates the exchange complex. This is based on the ligand exchange between F- and OH- which is on the edge of allophane so that OH- is free and will quickly replace the pH of solution (Simamore *et al*., 2015).

Soil Organic Matter

C-organic content in each soil ranges from 2,72 to 3,15% with moderate to high criteria. The content of soil organic matter in the soil ranges from 4,67 to 5,41%. According to Tan (1998), the high content of organic matter in the soil may be due to the presence of amorphous clay. Organic matter will produce humus that will bind to the Al and Fe into the Al-humus and Fe-humus or would happen polycondensation with amorphous minerals. Amorphous mineral compounds stabilized organic matter and protect them against biodegradation of microorganisms and stimulate the accumulation of organic compounds in the soil. These compound will be stable and remain in the soil and will not have movement (Resman, 2010). In addition, high clay content in the soil also effects the content of organic matter in the soil. Clay fraction has an influence on soil organic matter because the largest specific surface area is 800 m^2/g. The large surface area has a high activity in water adsoprtion, so that the soil which is dominated by clay fraction will have a high water holding capacity with low pore aerase. The low pore aerase causes a semi-anaerobic state so that the air exchange is not smooth. This affects the decomposition of organic matter that will undergo humification process to produce organic compounds that are resistant to weathering (Stevenson, 1982; Darmawijaya, 1992).

Base Cations and Base Saturation

Based on the results, the value of base cations in the soil varies from very low to high, base saturation is very low to high with a value of 16,8 – 70,98%. Ca^{2+} content in the soil ranges from 1,96 – 4,51 me/100g of soil (very low to high), Mg^{2+} content in the soil ranges from 1,25 – 1,95 me/100 g of soil (moderate), K^{+} content ranges from 0,59 – 0,92 me/100 g of soil (high), and Na^{+} content ranges from 0,46 – 0,9 me/100 g of soil (high). The low Ca and Mg values in the soil caused by leaching due to high rainfall. Ca and Mg cations are the most occupying the surface of colloids, so that when rainfall was high, leaching will occur and base cations will be lost (Yulius *et al*., 1985). Bases that can be exchanged have a relationship with base saturation, cation exchange capacity, and pH. If the soil pH is high, the base saturation will tend to be high because many base cations are absorbed in the soil colloid, conversely if the pH is low, the base saturation will tend to be low because the cation ansorbed in the ground colloid is dominated by Al and Fei ons (Nyakpa *et al*., 1988).

Phosphate Retention

The phosphate retention in each soil show values ranging from 35,5 to 97,5%. The high phosphate retention in soil is due to the amorphous iron and aluminium content derived from aluminium hydroxides and allophane. Al-OH and Al-OH_2 functional groups contained in amorphous mineral are very important in absorbing phosphate ions. Aluminol group is a hydroxyl anion which has a single bond to the aluminium metal. This single bond causes OH to be easily exchanged by phosphate ions through the ligand exchange mechanism. The more aluminol groups in amorphous materials such as allophane, the more phosphate is absorbed in the soil (Bohn *et al*., 1979). According to Tan (1984), a high phosphate retention resulted in phosphate becomes insoluble and unavailable to plants. Phosphate retention in one of the requirements of andic soil properties if phosphate retention more than 85%. Fiantis (2002) states that high phosphate retention in soils is directly proportional to allophane present in volcanic soil and the P-bond by allophane cannot be released by the help of organic matter.

Al, Fe, and Si Oxalate Extract Content

The metal content of Fe oxalate extract (0,41 – 9,2%) was higher compared to Al (0,26 – 2,38%) and Si (0,14 – 0,52%) for all soil profiles. The content of Si is lower than Al and Fe because Si ions are more mobile and easier to leaching than Al and Fe so Si leached in the top soil will be lossed and accumulated in the sub soil, whereas Al and Fe more easily make humus complex (Ajidirman, 2010). This is supported by the agreement of Van Ranst (1993) that materials which are rich in weathered minerals such as volcanics substnaces which produce top layers containing high Al and Fe. This situation increases the composition of complexes with relativiely high metals to that only slighlty soluble in air. Soils that have Andic soil properties must meet the requirements set forth in Soil Taxonomy. One of the requirements that must be met is the value of Al_o + ½ Fe_o contents ≥ 2%. The value of Al_o + ½ Fe_o eligible andic soil is on 3rd, 4th, and 6th soil profiles with values ranging from 2,145 to 5,01%. The high content of Al, Fe, and Si Oxalate extract in these three soils indicates the presence of amorphous material. Amorphous clay minerals such as allophane, imogolith, Al/Fe-Oxide, Al/Fe-hydroxides, and ferrihydrite has a main constituent mineral soil colloids (Wada, 1985).

Melanic Index

The deeper the depth of the soil, the value of the melanic index also decreases. This is duet o the low fulvic and humic substances as indicators of the melanic index (Hulu, 2019). Melanic index is used for the melanic epipedon characteristics requirements which the melanic indeks value must be ≤ 1,7 in cumulative soil thickness of 30 cm. In this research, there was no soil profiles that qualified as a melanic epipedon. This index is associated with the rasio of humic and fulvic acids in the organic fraction of the soil (Honna *et al*., 1988). The melanic index is used to differentiate accumulate organic matter which is though to be produced from large amounts of graminae vegetation from humidified organic matter formed from forest vegetation. Melanic index is calculated as the absorbance of the extract solution at a wavelength of 450 nm divided by the absorbance at a wavelength of 520 nm (Soil Survey Staff, 2014).

Soil Classification

In this research, soil parent material derived from pumice tuff formation and rocks andesite Mount Malintang and produce volcanic soil with Andic soil properties. Based on Soil Survey Staff (2014), Andic soil is a soil that has a bulk density ≤ 0,90 g/cm^3, phosphate retention ≥ 85%, and Al_o + ½ Fe_o content ≥ 2%. From the results, it is obtained in 3rd soil profiles meets the characeristics of the Andic soil. In classifying the soil, it is necessary to determine the identifier epipedon and horizon based on data obtained from observing and analyzing soil properties in the laboratory. Based on the data, all soil profiles meet the requirements of umbic epipedon which the soil has a thickness of more than 18 cm, the soil structure is sufficiently developed and soft if it dry has colors with values and chroma ≤ 3 (wet) and ≥ 5 (dry), base saturation (NH4OAc) ≤ 50%, and average C-organic content ≥ 0,6% and moist for 90 cumulative days throughout the year.

After identifying the epipedon, it is followed by identification identifier diagnostic horizon, which both soils meet the requirements as a cambic horizon. Soil has a subsurface horizon thickness of ≥ 15 cm, with a fine soil texture and not hard soil, soil color does not change when opened in the air, and genetic soil development without extreme clay accumulation.

After determining the identifier epipedon and horizon on the soil profiles, it is followed by determining soil ordo based on the Soil Taxonomy by Soil Survey Staff (2014). The 1st, 2nd, 4th, 5th, 6th, and 7th soil profiles when viewed from morphology, identifier epipedon as well as subsurface horizons belong to the Ordo Inceptisols. According to Hardjowigeno (2015), Inceptisols are soils with a cambic horizon with the upper limit at a depth 10 cm from the surface and its lower limit at a depth of more than 25 cm. The 3rd soil profile meet the requirements of the andic soils so that belong to Ordo Andisols. Andisols are soils that have 60% of the thickness of the andic soil properties with 36 cm thick or more at depths of less than 60 cm (Soil Survey Staff, 2014).

Soil classification at the Sub Ordo level was determined based on the soil moisture regime, which in the research site has a Udic regime so that the Sub Ordo at 1st, 2nd, 4th, 5th, 6th, and 7th soil profiles are Udepts and the 3rd soil profiles is Udands. The Greatgroups category in 1st, 2nd, 4th, 5th, 6th, and 7th soil profiles is Dystrudepts because the soil has a base saturation (NH4OAc) less than 60% and 3rd soil profile is Hapludands because the soil properties does not qualify for the other greatgroups. At the Sub Group level, the 1st, 2nd, 4th, 5th, 6th, and 7th soil profiles were classified into Andic Dystrudepts because all horizons has a thickness more than 16 cm with fine soil fractions with bulk density less than 1 g/cm3 and have a total Al_o and ½ Fe_o percentage more than 1%. The 3rd soil profile was classified as Typic Hapludands because the soil properties does not meet requirements of other subgroups.

At the Family level, soil classification based on three types were grain structure, mineralogy class, and soil temperature regime. In the 1st, 2nd, 4th, 5th, 6th, and 7th soil profiles have fine silt grain size (having less than 15% weight of particles with 0,1 – 7,5 mm in diameter, fine soil fractions having clay content of 18 – 35%). In the 3rd soil profile, it has a medial grain size because it only has fractonal of stones less than 35%. The mineral classes in 3rd soil profile belong to the Amorphic class with values of 8 × Si_o + 2 × Fe_o > 5% and 8 × Si_o > 2 × Fe_o. The parent material derived from volcanic material and high rainfall causes the formatio of amorphic clay minerals at a further development will be followed by the kaolinite mineral. This can indicate that the mineral class in the 1st, 2nd, 4th, 5th, 6th, and 7th soil profile is kaolinite. The soil temperature regime class in all soil profiles were classified as isohypertermic.

Based on the results of the soil classification, it found differences in results of soil classification in Nagari Sungai Kamuyang presented by Solok Sheet Land Unit Map by the Soil and Agroclimate Research Center in 1990, of which only the 3rd soil profile shows the characteristics of the Andisol while the other profiles show the Inceptisol characteristics. This difference was due to the map issued as a data source was a small scale map of 1 : 250.000 while the map used in research sampling was a large scale map of 1 : 50.000. The difference in the map scale can causes differences in the detail of information obtained. According to Burrough (1986), map scale is a measure of the detail of data in conventional system mapping. The soil data presented in map form will be related to the scale. Large scale maps wills show detailed typology and information of soil series, while medium to small scale maps will presents associations of several soil series and family. In addition, maps with a scale of 1 : 250.000 are known as derivative maps, which are maps that were not made directly from stereoplatting or surveys but were made using maps that already existed as a source on a larger scale. This affects the appearance of points, lines, and areas that results changes in the amount of length and area (Hisanah *et al.*, 2015). This is also supported by Hariyono's research (2018) found in the analysis of maps with two different scale of 1 : 50.000 and 1 : 250.000, there has been a change in the geometrical shape of objects on the scale change from medium to small scale. There are classes that changes in a sizem decrease in size, or are eliminated.

Conclusions

Based on the results of research on Soil Classification in Nagari Sungai Kamuyang, Luak District, Limapuluh Kota Regency, West Sumatra, it was found that differences in the results of soil calssificaton were presesented by the Solok Sheet Land Unit Map by Soil and Agroclimate Research Center in 1990, which is only on the 3rd profile shows the Andisol characteristics while in other soil profiles it shows the characteristics of Inceptisols. The results of soil classification based on the Soil Taxonomy System on the 1st, 2nd, 4th, 5th, 6th, and 7th soil profiles in Jorong Madang Kadok, Jorong Batang Tabik, Jorong Rageh, Jorong Tabing, and Jorong Subaladung were classified as Ordo: Inceptisols, Sub Ordo: Udepts, Greatgroups: Dystrudepts, Subgroups: Andic Dystrudepts, Family: Fine silt, Kaolinite, Isohypertermic, Andic Dystrudepts. In the 3rd soil profile which is in Jorong Madang Kadok area, was classified as Ordo: Andisols, Subordo: Udands, Greatgroups: Hapludands, Subgroup: Typic Hapludands, Family: Medial, Amorphic, Isohypertermic, Typic Haplundands.

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Soil Physical Characteristics

Table 1. Soil Bulk density and Texture in Nagari Sungai Kamuyang

Profile	Horizon	Depth (cm)	Texture				Bulk density (g/cm^3)
			% Sand	% Silt	% Clay	Class	
1	A	0 – 14	21,95	59,33	18,72	Silty loam	0,82
	B1	14 – 70	8,75	12,15	79,1	Clay	0,77
	B2	70 – 130	20,21	16,48	63,31	Clay	
2	A0	0 – 10	20,81	16,46	62,73	Clay	0,88
	A1	10 – 30	17,35	50,2	32,45	Clay	
	A2	30 – 62	41,12	8.81	50,07	Clay	
	B1	62 – 89	26,08	17,71	56,21	Clay	0,82
	B2	89 – 100	43,27	10,61	46,12	Clay	
3	A0	0 – 2	17,07	3,18	79,75	Clay	0,69
	A	2 – 18	20,18	6,64	73,18	Clay	
	B1	18 – 48	13,62	12,31	74,07	Clay	0,59
	B2	48 – 79	17,78	10,25	71,97	Clay	
	B3	79 – 100	15,55	10,88	73,57	Clay	
4	A	0 – 39	20,42	30,24	49,34	Clay	0,72
	B	39 – 110	23,86	35,07	41,07	Clay	0,88
5	A0	0 – 9,5	28,91	7,88	63,21	Clay	0,83
	A1	9,5 – 30	9,86	46,65	43,49	Silty clay	
6	A	0 – 10	35,37	15,35	49,28	Clay	0,87
	A1	10 – 26	37,09	17,11	45,8	Clay	
	B1	26 – 40	40,73	2,57	56,7	Clay	0,74
	B2	40 – 67	18,8	19,44	61,76	Clay	
	B3	67 – 100	75,03	3,1	21,87	Sandy clay loam	
7	A	0 – 30	9,84	9	81,6	Clay	0,84
	B1	30 – 50	9,86	18	72,14	Clay	0,79
	B2	50 – 100	9,88	31,46	58,66	Clay	

Soil Chemical Characteristics

Soil Reaction (pH)

Table 2. Soil Reaction in Nagari Sungai Kamuyang

Profile	Horizon	Depth (cm)	pH		Delta pH	pH NaF	
			H_2O	KCl		1 minute	60 minute
1	A	0 – 14	4,65	4,16	-0,49	9,61	10,29
	B1	14 – 70	4,84	3,92	-0,92	9,9	10,58
	B2	70 – 130	4,79	4	-0,79	10,09	10,76
2	A0	0 – 10	5,67	5,02	-0,65	10	11,2
	A1	10 – 30	5,23	4,48	-0,75	10,43	10,76
	A2	30 – 62	5,09	4,32	-0,77	10,08	10,81
	B1	62 – 89	5,19	4,4	-0,79	10,37	11,08
	B2	89 – 100	5,16	4,4	-0,76	10,38	11,1
3	A0	0 – 2	4,56	4,18	-0,38	10,17	10,85
	A1	2 – 18	4,62	4,16	-0,46	10,73	11,34
	B1	18 – 48	4,98	4,53	-0,45	11,35	11,71
	B2	48 – 79	5,07	5,09	-0,02	11,49	11,76
	B3	79 – 100	4,98	4,2	-0,78	10,79	11,38
4	A	0 – 39	6,75	6,02	-0,73	9,7	10,14
	B	39 – 110	6,37	5,07	-1,3	10,68	11,21
5	A0	0 – 9,5	6,09	4,87	-1,22	8,7	8,97
	A1	9,5 – 30	6,49	5,52	-0,97	8,91	9,25
6	A	0 – 10	5,33	4,36	-0,97	8,69	9,05
	A1	10 – 26	6,01	4,96	-1,05	9,27	9,73
	B1	26 – 40	5,75	4,85	-0,9	9,46	9,96
	B2	40 – 67	6,05	5,15	-0,9	8,81	9,18
	B3	67 – 100	6,02	5,05	-0,97	8,99	9,33
7	A	0 – 30	4,75	4,17	-0,58	9,57	10,06
	B1	30 – 50	4,96	4,16	-0,8	10,27	10,81
	B2	50 – 100	5,15	4,17	-0,98	10,22	10,9

Soil Organic Matter

Table 3. C-organic content and Soil Organic Matter in Nagari Sungai Kamuyang

Profile	Horizon	Depth (cm)	% C-organik	% Organic Matter
1	A	0 – 14	3,23	5,55
	B1	14 – 70	2,87	4,93
	B2	70 – 130	2,83	4,86
2	A0	0 – 10	3,1	5,33
	A1	10 – 30	3,05	5,24
	A2	30 – 62	3,05	5,24
	B1	62 – 89	2,93	5,03
	B2	89 – 100	3	5,16
3	A0	0 – 2	3,03	5,21
	A1	2 – 18	3,03	5,21
	B1	18 – 48	3,12	5,36
	B2	48 – 79	3,1	5,33
	B3	79 – 100	2,9	4,98
4	A	0 – 39	3,25	5,59
	B	39 – 110	2,9	4,98
5	A0	0 – 9,5	3,05	5,24
	A1	9,5 – 30	2,85	4,990
6	A	0 – 10	2,87	4,93
	A1	10 – 26	2,82	4,85
	B1	26 – 40	2,72	4,67
	B2	40 – 67	3	5,16
	B3	67 – 100	2,82	4,85
7	A	0 – 30	3,15	5,41
	B1	30 – 50	3,12	5,36
	B2	50 – 100	3,05	5,24

Base Cations and Base Saturation

Table 4. Base Cations and Base Saturation in Nagari Sungai Kamuyang

Profile	Horizon	Depth (cm)	Base Cations (me/100 g)				Base Saturation (%)
			Ca	Mg	K	Na	
1	A	0 – 14	1,99	1,95	0,68	0,53	21,69
	B1	14 – 70	3,32	1,65	0,64	0,71	35,68
	B2	70 – 130	1,96	1,88	0,7	0,5	23,35
2	A0	0 – 10	2,38	1,68	0,77	0,58	28,14
	A1	10 – 30	2	1,55	0,68	0,62	23,11
	A2	30 – 62	2,46	1,45	0,72	0,67	28,02
	B1	62 – 89	2,47	1,58	0,59	0,67	26,85
	B2	89 – 100	2,87	1,25	0,71	0,69	26,90
3	A0	0 – 2	2,66	1,44	0,86	0,84	29,95
	A1	2 – 18	2,32	1,83	0,68	0,74	26,31
	B1	18 – 48	2,99	1,79	0,66	0,82	34,07
	B2	48 – 79	2,27	1,58	0,73	0,84	33,89
	B3	79 – 100	2,51	1,48	0,61	0,85	18,42
4	A	0 – 39	3,36	1,81	0,6	0,9	22,70
	B	39 – 110	2,01	1,85	0,68	0,76	20,76
5	A0	0 – 9,5	2,36	1,85	0,79	0,7	22,68
	A1	9,5 – 30	4,51	1,9	0,92	0,84	70,98
6	A	0 – 10	3,08	1,74	0,86	0,89	20,69
	A1	10 – 26	3,9	1,62	0,63	0,65	38,09
	B1	26 – 40	3,14	1,74	0,67	0,58	28,93
	B2	40 – 67	3,24	1,62	0,84	0,59	16,80
	B3	67 – 100	3,15	1,67	0,83	0,46	23,71
7	A	0 – 30	3,62	1,8	0,82	0,77	20,91
	B1	30 – 50	3,9	1,89	0,73	0,71	27,28
	B2	50 – 100	4,44	1,94	0,76	0,85	27,06

Phosphate Retention and Al, Fe, Si, Oxalate Extract Content

Table 5. Phosphate retention and Al, Fe, Si Oxalate Extract Content in Nagari Sungai Kamuyang

Profile	Horizon	Depth (cm)	Oxalate Extract (%)			Al_o+ ½ Fe_o	Phosphate retention (%)
			Al	Fe	Si		
1	A	0 – 14	0,73	1,02	0,14	1,24	61,14
	B1	14 – 70	0,58	0,88	0,24	1,02	66,1
	B2	70 – 130	0,5	0,41	0,14	0,705	57,8
2	A0	0 – 10	1,03	1,76	0,21	1,91	78,5
	A1	10 – 30	1,15	1,91	0,28	2,105	82,1
	A2	30 – 62	0,79	1,42	0,29	1,5	77,9
	B1	62 – 89	0,73	1,98	0,26	1,72	77,7
	B2	89 – 100	0,73	2,02	0,24	1,74	84,6
3	A0	0 – 2	1,38	2,67	0,26	2,715	87,6
	A1	2 – 18	1,48	2,96	0,3	2,96	82,1
	B1	18 – 48	1,91	3,54	0,38	3,68	94,3
	B2	48 – 79	2,38	3,89	0,52	4,325	97,5
	B3	79 – 100	0,9	1,79	0,29	1,795	83,1
4	A	0 – 39	0,89	2,61	0,32	2,195	58,9
	B	39 – 110	1,1	2,18	0,34	2,19	77
5	A0	0 – 9,5	0,26	2,59	0,27	1,555	35,5
	A1	9,5 – 30	0,26	3,26	0,26	1,89	35,5
6	A	0 – 10	0,34	3,98	0,26	2,33	53,8
	A1	10 – 26	0,4	3,49	0,22	2,145	51,3
	B1	26 – 40	0,45	4,02	0,25	2,46	52,6
	B2	40 – 67	0,29	5,8	0,32	3,19	58,3
	B3	67 – 100	0,46	9,1	0,26	5,01	60,6
7	A	0 – 30	0,63	1,45	0,21	1,355	63,3
	B1	30 – 50	0,65	0,86	0,24	1,08	69
	B2	50 – 100	0,59	0,75	0,3	0,965	68

Melanic Index

Table 6. Soil melanic index in Nagari Sungai Kamuyang

Profile	Horizon	Depth (cm)	Melanic index
1	A	0 – 14	1,76
	B1	14 – 70	1,5
	B2	70 – 130	0,75
2	A0	0 – 10	1,92
	A1	10 – 30	1,65
	A2	30 – 62	1,89
	B1	62 – 89	1
	B2	89 – 100	2
3	A0	0 – 2	1,88
	A1	2 – 18	1,86
	B1	18 – 48	1,87
	B2	48 – 79	1,77
	B3	79 – 100	1,6
4	A	0 – 39	1,76
	B	39 – 110	1
5	A0	0 – 9,5	2
	A1	9,5 – 30	1,33
6	A	0 – 10	2
	A1	10 – 26	1,56
	B1	26 – 40	1,76
	B2	40 – 67	1,39
	B3	67 – 100	1,15
7	A	0 – 30	1,68
	B1	30 – 50	1,5
	B2	50 – 100	1,5

Soil Morphology Characteristics

Figure 1. 1st Soil Profiles

Figure 2. 2nd Soil Profiles

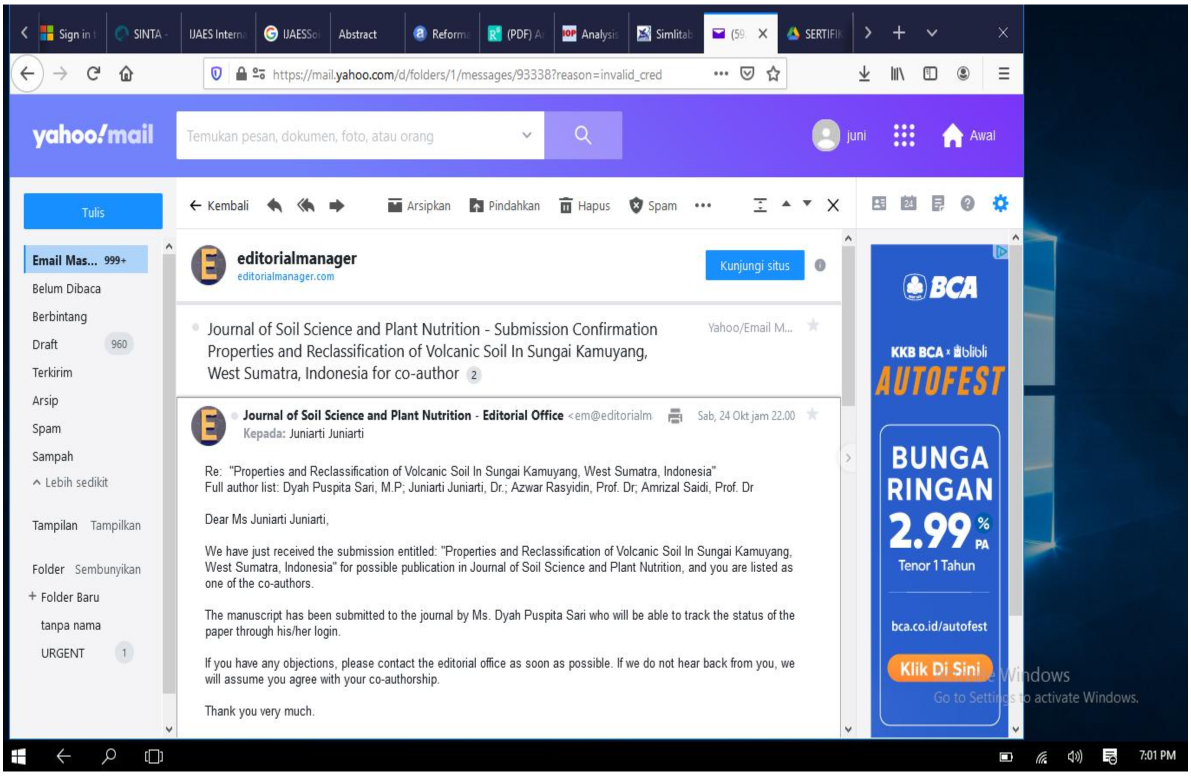
Figure 3. 3rd Soil Profiles

Figure 4. 4th Soil Profiles

Figure 5. 5th Soil Profiles

Figure 6. 6th Soil Profiles

Figure 7. 7th Soil Profiles



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Journal of Soil Science and Plant Nutrition - Submission Confirmation Properties and Reclassification of Volcanic Soil In Sungai Kamuyang, West Sumatra, Indonesia for co-author 2

Journal of Soil Science and Plant Nutrition - Editorial Office <em@editorialm... Sab, 24 Okt jam 22.00
Kepada: Juniarti Juniarti

Re: "Properties and Reclassification of Volcanic Soil In Sungai Kamuyang, West Sumatra, Indonesia"
Full author list: Dyah Puspita Sari, M.P; Juniarti Juniarti, Dr.; Azwar Rasyidin, Prof. Dr; Amrizal Saidi, Prof. Dr

Dear Ms Juniarti Juniarti,

We have just received the submission entitled: "Properties and Reclassification of Volcanic Soil In Sungai Kamuyang, West Sumatra, Indonesia" for possible publication in Journal of Soil Science and Plant Nutrition, and you are listed as one of the co-authors.

The manuscript has been submitted to the journal by Ms. Dyah Puspita Sari who will be able to track the status of the paper through his/her login.

If you have any objections, please contact the editorial office as soon as possible. If we do not hear back from you, we will assume you agree with your co-authorship.

Thank you very much.

Daftar capaian Luaran Tambahan belum diisi:

1. Paten produk, target: Terbit nomor pendaftaran paten sederhana