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Quantifying erosion with fallout radionuclide, and its relationship with soil properties for various land use in the Upper Ciliwung watershed Indonesia

Emma Trinurani Sofyan[1*], Sri Malahayati Yusuf[2,3], Ania Citraresmini[1], Taufiq Bachtiar[4] and Asep Mulyono[4]

[1] *Soil Chemistry and Plant Nutrition, Faculty of Agriculture, Padjadjaran University, Indonesia*
[2] *Department of Soil Science and Land Resources, Faculty of Agriculture, IPB University, Indonesia*
[3] *Environmental Research Center, IPB University, Indonesia*
[4] *National Research and Innovation Agency, Indonesia*
[*] *Corresponding author:* emma.trinurani@unpad.ac.id

Abstract

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Soil erosion causes the loss of the top soil layer, which is the most fertile part of the soil for plants. This experiment was conducted to study the impact of land use along Upper Ciliwung Sub-Watershed, on erosion potential, and its relationship with nutrient dynamics. Erosion estimation was determined using the Radionuclide Fallout technique, where the difference in inventory values of ^{137}Cs or ^{210}Pb between the reference area, and the sampling area was the basis for determining the erosion potential. The undisturbed forest area in Megamendung-Puncak West Java is determined as a reference area to obtain ^{137}Cs and ^{210}Pb inventory values that can provide comprehensive reference data. The sampling area was determined based on land use differences: moors, bare land, and mixed gardens. Multiple transect technique is used as a sampling method, to collect soil samples by using soil corer. To determine the vertical distribution of ^{137}Cs and ^{210}Pb in the soil layer, sampling was taken with the increment of the soil layer from 2 cm to the depth of 20 cm. The results showed that the inventory value of ^{137}Cs and ^{210}Pb in the bare land study area was lower than the reference area, proving fairly high erosion potency, where the net erosion values were 20 t/ha/yr up to 63.07 t/ha/yr, respectively. Data on soil chemical properties offer a thorough justification for the erosion potency, where N-total and C-organics are positively correlated with the presence of ^{210}Pb. In contrast, base saturation is positively correlated with the presence of ^{137}Cs.

Keywords: radionuclide; erosion; land use; Ciliwung watershed; soil properties; ^{137}Cs

Introduction

Soil erosion is influenced by various factors including soil properties, landslope, vegetation coverage and distribution, as well as the quantity and strength of rainfall, and also land management actions. These factors can significantly impact the quality and productivity of the soil by leading to the depletion of the richest topsoil. Agricultural land management practices in the Indonesia watershed by farming communities still largely do not implement soil and water conservation aspects, giving rise to several land degradation problems due to soil erosion. Generally, soil erosion originating from dry agricultural land in Indonesia exceeds 15 tons/ha/year (Hidayat et al., 2012). Farmers in Indonesia face challenges in implementing conservation aspects in managing their agricultural land due to various factors. Studies highlight that the effectiveness of conservation policies relies on farmers' financial capabilities, land tenure, and physical land conditions (Dharmawan et al., 2023). Additionally, the lack of efforts in promoting conservation technologies has led to increased critical land areas, particularly in Java Island, emphasizing the importance of environmental awareness among farmers (Sumaryanto et al., 2022).

The upstream Ciliwung watershed has a total area of 15,258 hectares and functions as flood control in Jakarta, however extreme changes in land use in this area have resulted in increased direct runoff (Ruspendi et al., 2013). Direct runoff has increased up to 83% in periode of 1994 – 2010, caused by settlement area and dry land farming along with the decrease of forest area (Nuraida et al., 2016). According to the Ministry of Environmental and Forestry Indonesia (Santoso et al., 2019), the upper Ciliwung watershed has been damaged and classified as in recovery watershed. Due to this condition, all the stakeholders related to the management of the Upper Ciliwung watershed should be very concerned about its sustainability. To avoid land degradation, particularly erosion, soil conservation measures must be performed. However, conservation measures will not be effective if an area's erosion risk level is unknown.

There are several methods for measuring erosion, either directly using erosion plots, modeling, and using isotopes. The use of isotopes method for soil movement at a watershed scale has been developed to help better understand in erosion analysis (Bernard and Mabit, 2007). The use of Cs and Pb isotope counts as markers of soil erosion rates and patterns has been widely researched in several areas. This method also has been widely used in Indonesia, because the soil sampling technique is relatively simple, even though quite complicated data processing is required, the resulting data is more precise. In Indonesia, isotopes method was started in 1996 (Aliyanta et al., 1996) and followed by a series of research results, including Suhartini et al. (2002), Suhartini et al. (2004), Aliyanta and Rahmadi (2009), Lubis and Aliyanta (2006), Aliyanta (2015), Aliyanta et al. (2016) and Murtilaksono et al. (2018). Studies have indicated that Cs isotopes, particularly ^{137}Cs, are useful for assessing soil erosion rates (Peñuela et al., 2023; Porto and Callegari, 2023; Zhang et al., 2023). Furthermore, Pb isotopes have been used to quantify soil erosion rates, with results showing that erosion intensity has decreased with time due to variables, such as crop disturbance (Ochirbat et al., 2022). While Cs isotopes are excellent in estimating erosion rates, Pb isotopes give useful insights into the historical history of soil erosion patterns, particularly in locations with unique geological properties such as limestone and sandstone (Dione, 2022). Therefore, both Cs and Pb isotope counts are excellent markers for understanding soil erosion processes.

Erosion correlates with various soil properties such as soil strength, aggregate size distribution, aggregate stability, and physico-chemical properties (Ortega et al., 2022; Shafii et al., 2023). Additionally, soil erosion is influenced by soil physico-chemical properties such as particle size distribution, bulk density, pH, organic matter content, and exchangeable acidity, which play a significant role in determining the susceptibility of soil to erosion (Shafii et al., 2023). Soil properties like texture, pH, total nitrogen, organic matter, calium, magnecium, calscium, cation exchange capacity, and phospor affected by erosion (Oriaku et al., 2022). Understanding these correlations between erosion and soil properties, is crucial for predicting and mitigating erosion in various environments.

The purpose of this research is to evaluate the quantity of soil erosion that occurs on different land use at Upper Ciliwung watershed, using Cs and Pb isotope as indicators. These studies are needed to evaluate soil erosion over time, identify areas at risk of degradation, and develop strategies to reduce soil loss across various land uses.

Materials and Methods

Study site

The study was conducted at Ciesek Sub-watershed, Upper Ciliwung watershed, Bogor Regency, West Java Province. The study area is located in Megamendung District, Puncak-Bogor, in the coordinate of 06°39′03.3″ N to 106°52′22.7″ S, and 1.319 m above sea level (Figure 1).

The area's topography is hilly, flat, and sloping with reddish-brown latosol soil types. Considering the location of Megamendung District is in the highlands, the average daily temperature is 22–26°C. Humidity reaches a high of 90% in the morning, and a low of 50% in the afternoon. Rainfall in this area averages 2,145 m per year. Soil condition at the location is dark and moist due to the accumulation of organic matter from vegetation that grows on the ground. The area is covered by vegetation, types of shrubs, vines and weeds, and also large trees of annual plants.

At the specified research location, there are 4 land uses, i.e., forest, mixed garden, moor and bare land (Table 1). The reference point inventory values is found in undisturbed locations, or with minimal anthropogenic disturbances in redistribution studies (Schuller and Walling, 2014). The forest has been selected as a reference in the Puncak area in Ciesek sub-watershed.

Mixed gardens are the area, planted with various plants, arranged spatially and temporally, with the dominant plant

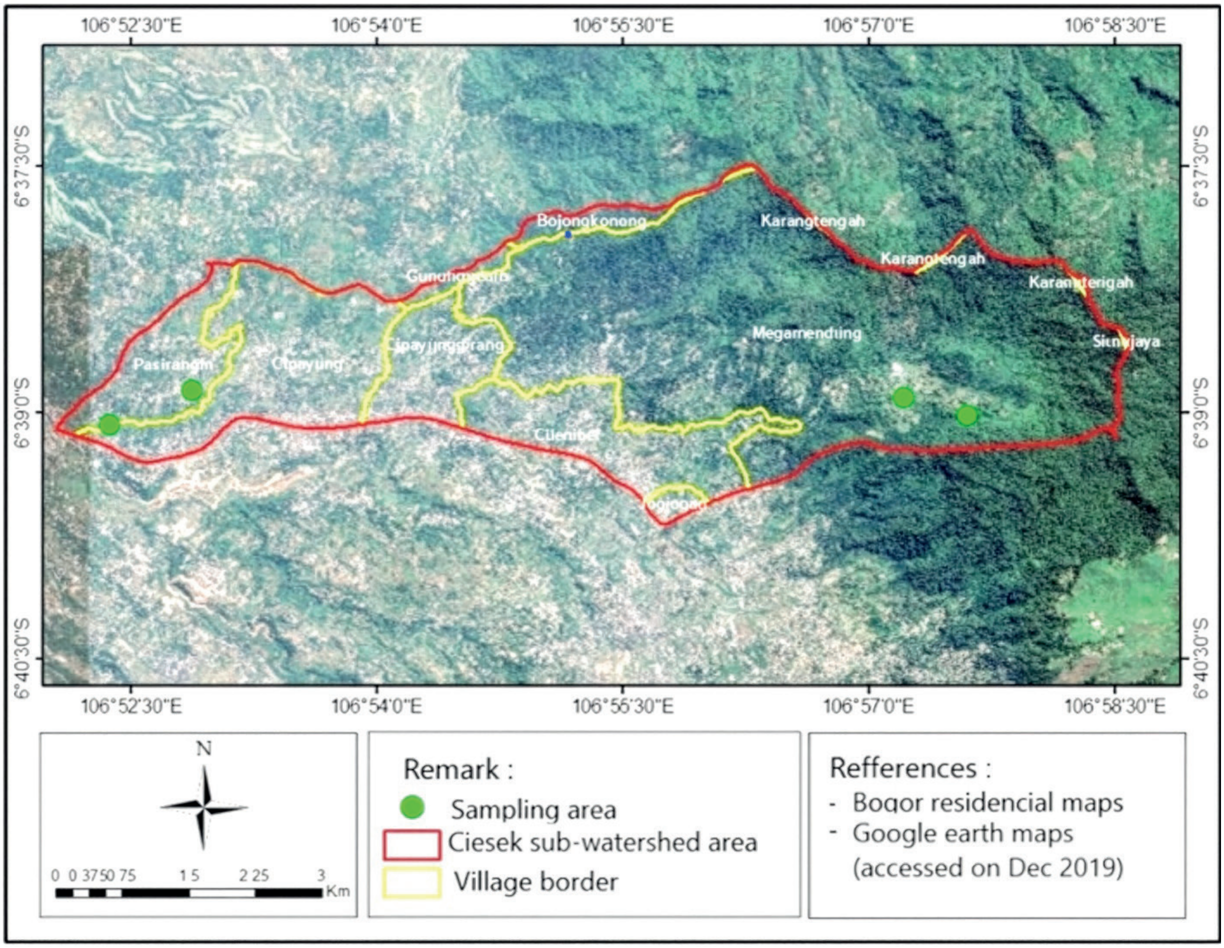

Fig. 1. Area of the study

Table 1. Study site characteristics

Land use	X	Y	Elevation (m)	Slope (%)	Location
Forest	0639′03.3″	10657′35.5″	1319	12	Megamendung village, Megamendung subdistrict, Bogor regency, West Java
Mixed garden	0638′54.2″	10657′13.3″	1173	15	Megamendung village, Megamendung subdistrict, Bogor regency, West Java
Moor	0638′52.5″	10652′4.1″	515	11	Pasir Angin village, Megamendung subdistrict, Bogor regency, West Java
Bare land	0639′04.0″	10652′22.7″	499	8	Pasir Angin village, Megamendung subdistrict, Bogor regency, West Java

Source: Authors' own elaboration

species being annual plants (Arsyad, 2006). The location of the mixed garden at the research location is in Megamendung Village, Megamendung District, Bogor Regency, West Java, with an altitude of 1173 m above sea level. Annual plants, including coffee, jackfruit, and avocado, dominate this location.

Moor is a land, generally planted with seasonal crops, and does not require a lot of water. The moor used for research is located in Pasir Angin Village, Megamendung District, Bogor Regency, West Java. The location is 515 meters above sea level cultivated by cassava, chili, and tomatoes. Soil sampling and measurements were only carried out on plots, planted with cassava once a year. The conservation technique used is the bench terrace.

Bare land is an area that have no or little vegetation. The location is in Pasir Angin Village, Megamendung District, Bogor Regency, West Java, at an altitude of 499 meters above sea level. The soil condition at the study site was covered by grass 60% on some of its surfaces.

Soil Sampling

Soil sampling was done in February – May 2019, in the reference area, and several land cover types consisted of mixed garden, bare land, and moor. The multiple transect technique is used as a sampling method, to collect soil samples, so that from the same land-use area, there are 3 sub-samples obtained (Figure 2). The samples consist of disturbed and undisturbed soil samples. Four cores of forest soil were taken, 13 cores of mixed gardens, 10 cores of dry land, and 8 cores of open land. Soil samples of the reference area (forest) were taken from the soil profile with a depth of 1 meter. To determine the vertical distribution of ^{137}Cs and ^{210}Pb in the soil layer, sample soil was taken using a scrapper with the increment of soil layer of 2 cm until the depth of 20 cm.

Laboratory analysis

The inventory value for each radionuclide of ^{137}Cs and ^{210}Pb excess, was generated from activity measurement using MCA (Multi-Channel Analyzer) tool, with a low energy detector and relative efficiency of 30% (Fulajtar et al., 2017). The analysis was done in PAIR-BATAN (Centre for Isotope and Radiation Application, National Nuclear Energy Agency), namely Research Organization of Nuclear Technology-BRIN nowadays, especially for low background counting.

Soil samples from the field, taken by several treatments: drying, aggregating, sifting, and weighing. A dried sample of 300-400 grams was stored in a Marinelli tube, tightly closed, and left for approximately 1 month. Therefore, it is expected that a balance has been reached between the activity of Ra-226, and its deceased. ^{137}Cs activity in samples was measured, based on decay at an energy of 661 KeV. The ^{210}Pb excess activity was measured in the energy of 46.5 KeV, as a representation of total ^{210}Pb activity, while ^{210}Pb supported was measured using the energy of 351 KeV through ^{210}Pb activity (Eakins, 1983; Lubis and Aliyanta 2006). ^{210}Pb excess radionuclide activity (Bq/kg) and ^{137}Cs (Bq/kg) in soil samples were determined based on a direct comparison with secondary standard material, which was measured in the laboratory in China. This activity value of Pb-210 access and ^{137}Cs then converts to cumulative activity per area (inventory) (Bq/m^2).

The erosion and deposition rate estimation were determined through mass balance conversion, and counted using

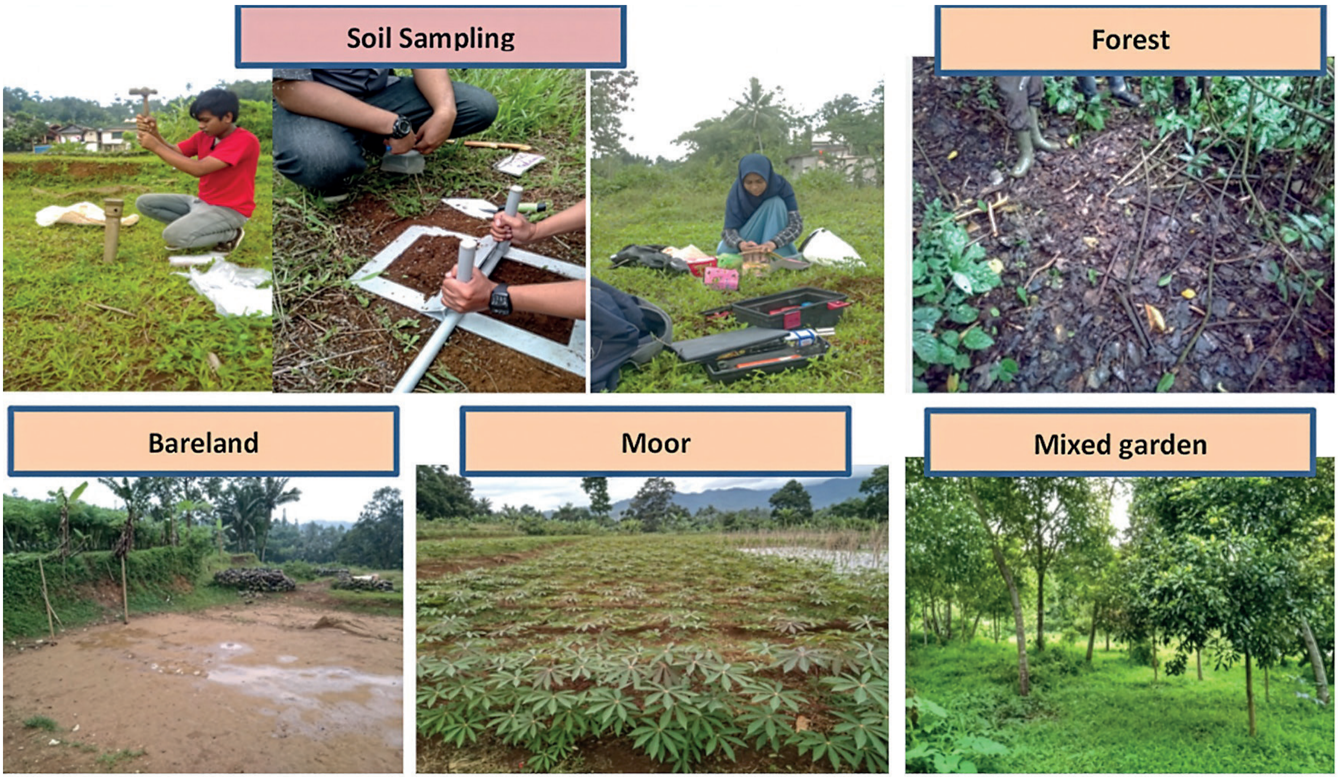

Fig. 2. Soil sampling in the different land use area
Source: Authors' own elaboration

inventory value at each point. This process was done using Radiocalc software (Aliyanta, 2014). The mass balance model was used to analyze the Cs-137. In addition, to the analysis of erosion estimation, an analysis of soil characteristics (soil physics, soil biology, and soil chemistry) was also carried out at soil physics laboratory, Department of Soil Science and Land Resource, Faculty of Agriculture, IPB University. Soil chemical analysis was conducted in the Soil Fertility and Nutrition Laboratory, Faculty of Agriculture Unpad. The parameters tested are the content of elements N, P, Ca, Mg, K, Na, CEC, C-organic and base saturation. The method used for soil characteristics analysis is presented in Table 2.

Table 2. Soil sample analysis method

Soil Characteristics	Method
Texture	Pipette method
Organic content	Walkley and Black
Water content Chemical: SB, CEC, N-total, P-total, Ca, Mg, K, Na	Gravimetric Destruction and destillation

Source: Authors' own elaboration

Data analysis

The research was carried out by applying a descriptive method to obtain information on erosion estimation, through the FRN technique. In addition, it also obtains information on land characteristics based on land use, as supporting data from the results of the calculation of erosion estimation, based on the inventory value of ^{137}Cs and ^{210}Pb excess.

The basic principle of the ^{137}C method for soil erosion assessment is based on the chemical characteristic of Cesium (Mabit et al., 2014). ^{137}Cs is a human-induced environmental radionuclide, released into the atmosphere by nuclear weapon testing in the 1950s and 1960s, whereby the radionuclide spread to the stratosphere, and gradually descended to the land surface. In addition, smaller regional contaminations were caused by nuclear power plant accidents (such as Chornobyl and Fukushima). When ^{137}Cs get into contact with soil material, it blends firmly with soil colloids and is often not transferred by processes such as leaching and plant uptake. It can move only together with soil particles, so any changes in its inventory show a distribution of soil particles by physical action.

A comparison of ^{137}Cs and ^{210}Pb data from the study and reference areas indicates erosion or deposition. The ^{137}Cs and ^{210}Pb counting numbers (Bq/m^2) were then calibrated on the Radiocalc software to obtain a value of erosion potential in the study area (ton/ha/yr). All data obtained are presented in tabular form, and statistical analysis is performed on each data in the parameters using PAST 3.18 software.

Result

^{210}Pb and ^{137}Cs in Soil

The measurement results of the activity of the ^{137}Cs and ^{210}Pb excess isotopes, or termed inventory, are used as a reference for the analysis of isotope quality and quantity. The inventory values of ^{137}Cs and ^{210}Pb in the references site (forest area) excess were 62.46 and 4433.55 Bq/m^2, respectively (Figure 3). The discrepancy between both nuclides can be seen clearly. The deeper the soil, the less presence of ^{210}Pb, in contrast to ^{137}Cs, where there is an additional concentration the deeper the soil.

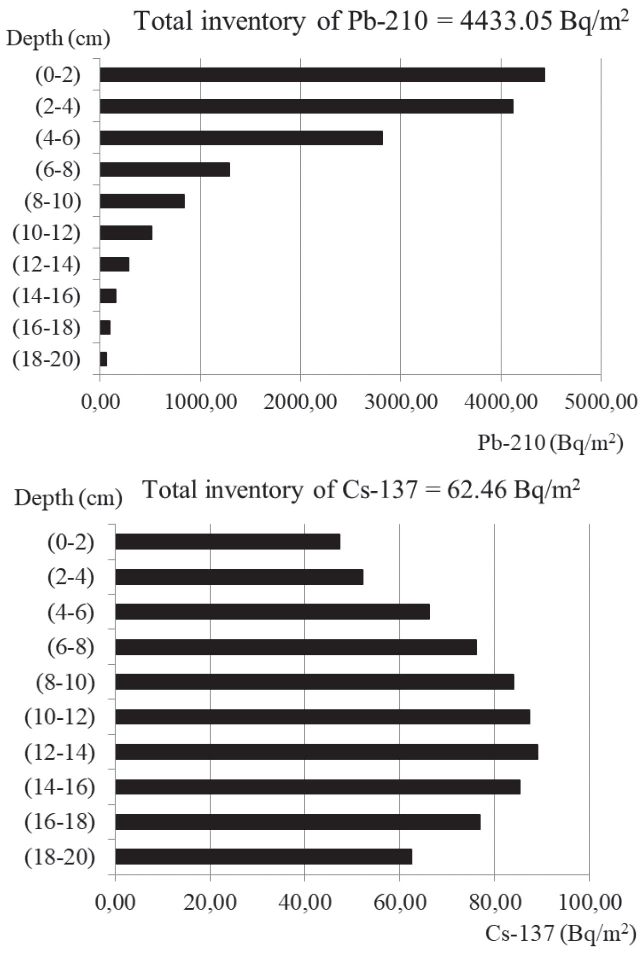

Figure 3. Profile distribution of 210Pb and 137Cs based on soil depth in the reference area

Source: Authors' own elaboration

Figure 4 shows the inventory of ^{210}Pb and ^{137}Cs at different land uses, that the total ^{210}Pb inventory for mix garden is 3581 Bq/m^2, bare land 1923 Bq/m^2 and moor is 3348 Bq/

m^2. Pb inventory is highest in mixed garden land use. As for Cs, the highest total inventory is on moor land use. Figure 4 shows the ^{137}Cs inventory for the mixed garden of 33.41 Bq/m^2, bare land of 48.54 Bq/m^2 and moor of 54.85 Bq/m^2.

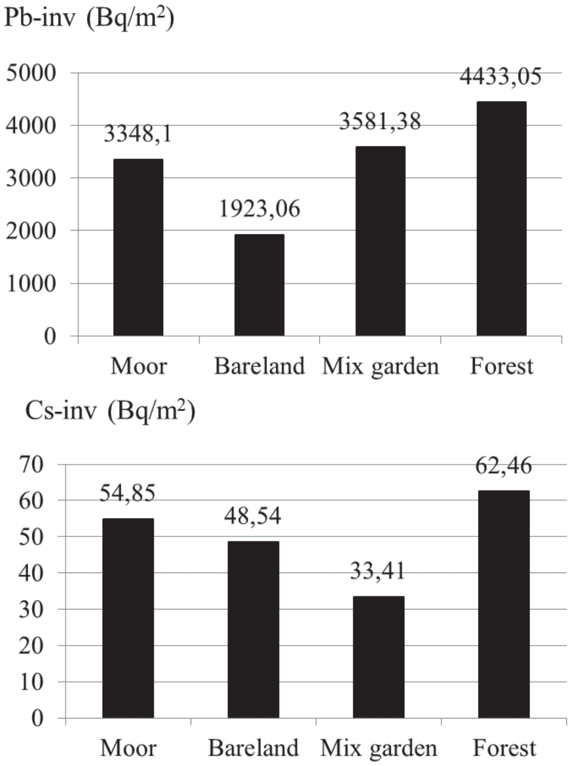

Figure 4. Total inventory of ^{210}Pb and ^{137}Cs at different land use

Source: Authors' own elaboration

Soil erosion estimation by ^{210}Pb and ^{137}Cs

The erosion potential (Figure 5) was determined after obtaining the ^{137}Cs and ^{210}Pb inventory values for access, which the forest as the reference values in the study area.

Figure 5 shows that the erosion estimation using ^{210}Pb gives a smaller value than the erosion estimation using ^{137}Cs. Based on the average erosion estimation, ^{137}Cs and ^{210}Pb values show the same result: the highest erosion rate was in the bare land. An erosion rate of 63.07 t/ha/year was estimated using ^{137}Cs, while an erosion rate of 20 t/ha/year resulted from using ^{210}Pb estimation.

Soil properties

Data analysis results are presented in Table 3, which shows the chemical characteristics of each land based on its use. In the forest area as a reference site, it can be seen

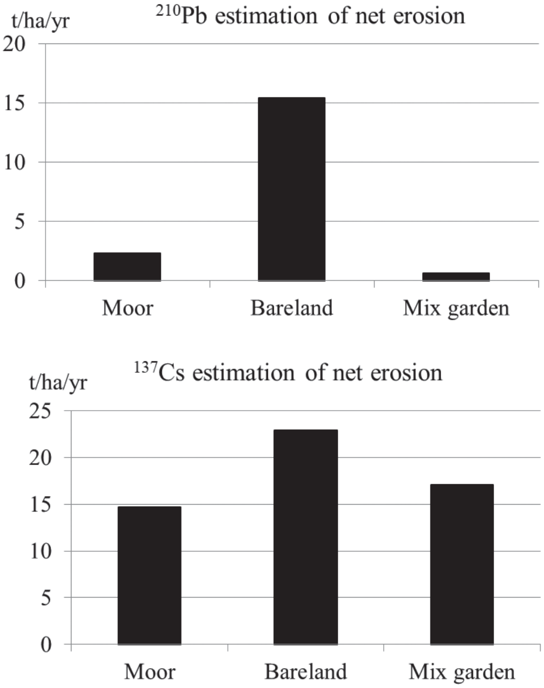

Figure 5. Erosion estimation using ^{210}Pb and ^{137}Cs at different land use

Source: Authors' own elaboration

that organic carbon content, cation exchange capacity, base saturation, and water content are relatively high. The moor land use shows very low aggregate stability, but very high P and clay content. The vegetation on this dry land in seasonal crops (tomatoes, chilies, and cassava) cultivated intensively. The high P content is suspected to come from fertilizer residues, given to plants (anthropogenic).

Similarly, the level of N is classified as moderate. The soil texture in the moor area has a fairly high clay content (64.63%), making the soil to have a large enough adsorption surface to absorb P. In this moor area, the conservation technique of bench terrace farming system is applied as the land use as seasonal crop agriculture.

Bare land shows higher aggregate stability compared to moor fields. This condition is due to the absence of processing, so the soil tends to compact. The absence of ground cover vegetation on it, causes the C-organic content of the soil to be very low compared to moor fields and mixed gardens. In the mixed garden area, the soil texture is dominated by silt (41.4%). High silt content indicates the soil's physical structure that has undergone further weathering, so that nutrient leaching is possible. This can be seen in the lowest base saturation parameter compared to other land use areas.

Table 3. Soil physical and chemical properties at different land use

	Ntot	P	Ca	Mg	K	Na	CEC	BS	Corg	Sand	Silt	Clay	Wc	Agr
	(%)	(ppm)	(cmol(+)/kg)				(me/100g)	(%)						
Forest	0.92	9.23	20.54	2.13	0.81	0.08	42.93	54.89	12.43	8.99	33.13	32.47	142.09	156.40
Mix Garden	0.5	7.4	4.06	0.84	0.67	0.12	30.03	18.92	6.33	4.02	41.4	30.75	63.87	189.75
Bare land	0.13	7.75	6.45	3.14	0.41	0.25	30.57	33.54	1.19	0.74	36.77	58.98	48.12	97.59
Moor	0.29	26.05	13.21	1.31	1.69	0.04	31.98	50.79	2.6	0.84	31.43	64.63	44.18	91.62

Remark : N-tot = N-total; CEC = Cation Exchange Capacity; BS = Base Saturation; C-org = Carbon organic; WC = Water Content ; Agr = Agregate.
Source: Authors' own elaboration

Discussion

Fallout radionuclide ^{137}Cs and ^{210}Pb excess, the fallout from the nuclear bomb explosion and nuclear accident more than 50 years ago, are assumed to still reach the ground surface and enter the soil profile in the Southern Hemisphere. According to Aliyanta (2007), developing and applying the ^{137}Cs method, widely in Indonesia, is not easy. Compared to the northern hemisphere, ^{137}Cs activity in the southern hemisphere is more difficult to measure, because of the small deposition activity due to radioactive decay and the absence of ^{137}C nuclide input (Schuller and Walling, 2014). Therefore, tropical areas have lower ^{137}Cs fall activity per unit area (inventory) than subtropical areas.

The result shows an ideal picture (Figure 3) of the ^{210}Pb inventory value, which is an exponential decrease in soil depth. According to Eakins (1983), Mabit (2011) and Lubis and Aliyanta (2006), ^{210}Pb excess drops to the ground surface with rainwater or sticks to mineral dust flying in the air. It will be strongly absorbed by fine soil particles to be used as a tracer of soil movement due to surface runoff. The ^{210}Pb value decreases further into the soil profile. It shows that fine soil particles cannot penetrate deeper into the depth, as the soil structure undergoes compaction along with the depth of the soil (Suhartini et al., 2020). So, this is an indication that the reference area is not disturbed, because ^{210}Pb does not move to the depth of the soil profile. The presence of ^{210}Pb in the depth of the soil profile is an indication of the displacement of this nuclide into the deeper soil layers due to the repositioning of the topsoil (Aliyanta, 2014, 2015). According to (Aliyanta, 2015), the activity profile of ^{210}Pb excess can provide an ideal picture of a stable location, where activity decreases exponentially with depth, and the highest activity is on the surface, presumably, because the ^{210}Pb excess is a fallout radionuclide that is produced continuously, due to the release of ^{222}Rn gas from the soil/rock that will fall to the ground in the form of ^{210}Pb excess.

The inventory value of ^{137}Cs in the forest area as a reference site shows an anomaly in the value changes. This reference value anomaly is thought to have occurred, because the land cover vegetation in the forest area was thick enough to interfere with the enumeration of the ^{137}Cs radionuclide. When ^{137}Cs get into contact with soil material, it blends firmly with soil colloids and is often not transferred by processes such as leaching and plant uptake. It can move only together with soil particles, so any changes in its inventory show a distribution of soil particles by physical action. The research findings of Suhartini et al. (2020) stated that if ^{137}Cs are absorbed by plants, this nuclide will be released into the soil after the plant dies and decomposes. In addition, the value of ^{137}Cs does not experience an increase like ^{210}Pb, because this nuclide is only produced by uranium decay, which is liberated into nature due to a nuclear accident. However, the two inventory values can be used to compare the research study area.

Referring to the symptoms of erosion estimation by ^{137}Cs and ^{210}Pb data, Lubis and Aliyanta (2006) and Aliyanta (2014) stated that the difference in the calculation of the erosion rate is due to an activity that is not detected by the tool, so that the assumption of the value given is the same as the detection limit of the tool. According to Porto and Walling (2012) and Meusburger et al. (2018), the minimum detection (MDC) for ^{210}Pb total is 7.7 Bq/kg, ^{210}Pb, supported is 5 Bq/kg, and ^{137}Cs is 0 Bq/kg. The actual conditions may differ for each point of the soil sample, where no radionuclide activity is detected. However, ^{210}Pb is as good as ^{137}Cs in the radionuclide fallout technique for estimating the erosion potential in a landscape. It only requires a higher instrument efficiency than the current instrument (> 30%).

Pearson correlation were performed to evaluate the soil properties on ^{210}Pb and ^{137}Cs distribution in all land use types (Table 4). In Table 4, at a significance level of 0.05, a positive correlation can be seen between total N, cation exchangeable capacity, organic C, and water content with ^{210}Pb. At the same time, Sodium has a negative correlation with ^{210}Pb. Calcium, base saturation, and exchangeable cation capacity positively correlate with ^{137}Cs, while silt negatively correlates with ^{137}Cs.

Table 4. Statistical correlation between soil properties on ^{210}Pb and ^{137}Cs

	^{210}Pb	^{137}Cs
N total	0.91	0.37
Phosphate	0.07	0.35
Calcium	0.66	0.92
Magnesium	-0.56	0.42
Kalium	0.31	0.35
Natrium	-0.80	-0.32
Cation exchangeable capacity	0.72	0.76
Base saturation	0.39	0.97
C organic	0.88	0.35
Sand	0.83	0.36
Silt	-0.22	-0.91
Clay	-0.67	0.24
Water content	0.76	0.54
Aggregate stability	0.60	-0.46

Source: Authors' own elaboration

In the bare land area, the erotion rate looks the smallest compared to other land use areas (Figure 5). The absence of vegetation in this area causes the content of N-total (0.13%) and C-organic (1.19%) to be low (Table 3 and Figure 6). This condition is to the results of research conducted by Hancock et al. 2010 and Teramage et al. 2013, which stated that the value of ^{210}Pb is more related to anthropogenic activities and distribution of soil nutrient minerals, especially in N-total and C-organic. The C-organic content in mix garden area is moderate, even quite good, compared to moor and bare land (Figure 6). The presence of trees in mixed gardens can also increase the water content, so that it has a higher content than bare land and moor. The existence of annual plant vegetation can provide fairly high water-holding power with the best aggregate stability. However, it is not enough to maintain Ca and CEC content, so in this case, the value of Ca and CEC levels in the mix garden looks the smallest compared to other land uses (Figure 6).

The stability of the aggregate and the erosion process can be reduced, as reflected in the mixed garden land use. Mix garden land use has a smaller erosion value than moor and bare land. The vegetation that grows on mixed garden land use is annual plants, namely coffee, jackfruit, and avocado. The roots of this plant are strong and deep to form good aggregate stability. High levels of C-organic are supported by land cover vegetation, which is annual plants, vines, and also litter from dead plants that fall to the ground and undergo decomposition (Fathiyah, 2013). In the moor land use areas, the conservation technique with bench terrace farming system is applied for seasonal crop agriculture. It is suspected that the conservation technique significantly reduces the erosion rate than bare land no conservation practice is used.

Additionally, incorporating nutrient-rich solutions like calcium chloride, potassium nitrate, magnesium sulfate, and various other elements in the cultivation process, enhances the nutrient content of the soil (Chongloi, 2021). Furthermore, research on mix gardens emphasizes the importance of soil types and compositions in retaining nutrients and promoting plant growth through evapotranspiration and infiltration mechanisms (Rothe and Binkley, 2001). Overall, the diverse components and nutrient solutions in mixed gardens

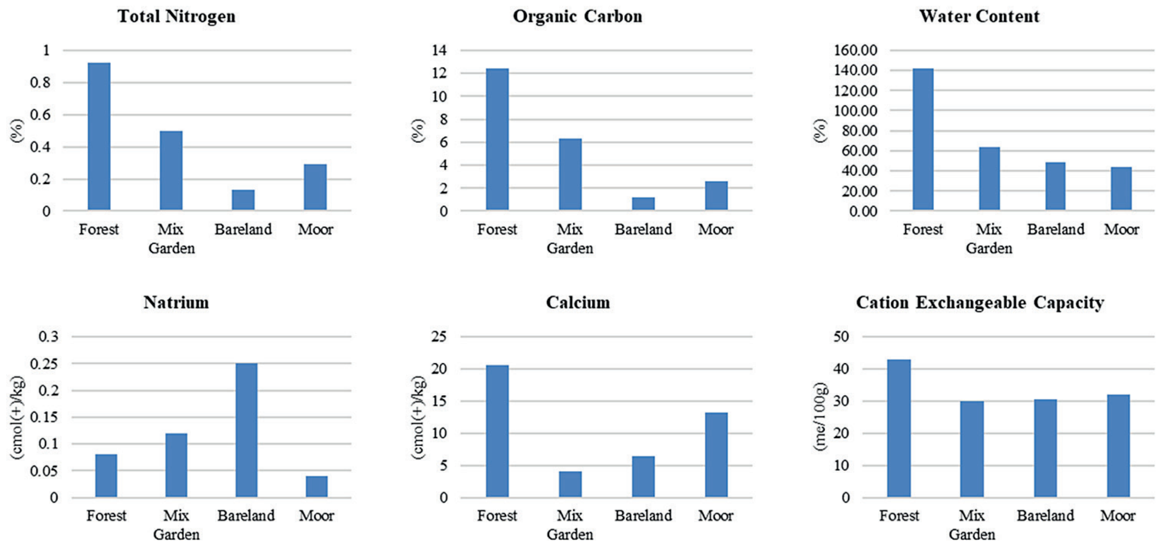

Fig. 6. Soil Properties graph at different land use
Source: Authors' own elaboration

contribute to better soil nutrient retention compared to conventional open fields and traditional gardens.

Conclusion

The erosion estimation results using ^{210}Pb provide a smaller value than the erosion estimation using ^{137}Cs. Based on the average erosion estimate, the values of ^{137}Cs and ^{210}Pb shows the same results, where the highest erosion rate is found on bare land with, respectively, 63.07 t/ha/year using ^{137}Cs, and the estimate using ^{210}Pb of 20 t/ha/year. The relationship between erosion values and soil properties shows a positive correlation for the parameters total nitrogen, cation exchange capacity, organic carbon, and water content with ^{210}Pb, but natrium has a negative correlation with ^{210}Pb. Calcium, base saturation, and cation exchange capacity were positively correlated with ^{137}Cs, while silt was negatively correlated with ^{137}Cs. Mixed gardens provide better soil carbon, nitrogen, water content, aggregate stability and texture. Mixed gardens can retain soil nutrients effectively compared to bare land and moor, due to their unique compositions and vegetation structures.

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Conflict of interest

We announce that the authors have no conflict of interest to declare.

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